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NOTES ON SOME TREES AND SHRUBS OBSERVED DURING A RECENT BOTANICAL EXPEDITION TO NORTH-EASTERN KUMAUN.

THE vegetation of this portion of Kumaun not having been previously explored, I venture to hope that a few notes on some of the trees and shrubs noticed during the expedition I made last August and September will be of interest to some of the readers of the "Indian Forester."

Without entering into unnecessary details, I will first of all give a short account of the route there and back. Starting from Naini Tál on the 9th of August, I proceeded *viâ* Almora to Bageswar on the Sarju river, and thence by Kapkot, Sáma, and Gini, to Munshiári in the Gori Valley. Here we halted for a couple of days in order to divide our baggage, despatching what we did not immediately want into Dárma by the Chipla route, intending ourselves if possible to cross by a higher pass from the Rálam Valley. From Munshiári we went up the Gori Valley to Páton, and thence to Rálam *viâ* Sába, collecting at the latter place several specimens of a most interesting little plant placed by Mr. Bentham in the natural order *Chloranthaceæ.* It was first found in this locality many years ago by General R. Strachey, who with Mr. Winterbottom made valuable and very extensive collections of Kumaun plants. All the specimens of this particular plant were, however, unfortunately lost before it could be satisfactorily placed in any known natural order. Its re-discovery was, therefore, an important object, and one which chiefly determined us to select this particular route.

At Rálam we had to remain three days waiting for coolies from Milam to take our loads across the Rálam Pass. The time was not by any means wasted, for the Rálam Valley has a very rich flora, and many rare species were collected. It took us three days getting over the pass into Dárma, the second night being spent on a glacier at an elevation of over 17,000 feet above the sea.

We halted for a couple of days at Shibu, one of the principal villages in Dárma, and from there we made for the Dhauli Valley and across the Lebung Pass into Byáns. After remaining a couple of days at Kutti, the highest village in the Byáns Valley, we made our way down to Kangua or Káwa, a village on the Nepal side of the Káli, which river comes in here from the direction of the Lipu Pass. From here we followed the course of the Káli Valley all the way to Askot, returning to Almora *viá* Bininág.

By this route a good idea may be obtained of the rainy season vegetation of this section of the Himalayas, both tropical, temperate and alpine, the altitudes ranging between about 2,500 feet to over 18,000 feet above the sea. As only two months were spent over this journey, it was not possible to make anything like a complete exploration of the districts through which we passed, and many interesting plants must have escaped our notice altogether. The following notes, however, are offered as a small contribution to our knowledge of the trees and shrubs of North-East Kumaun.

Schyzandra grandiflora, H. F. & T.—Forests near Sosa, where it is called *sirkul*.

Berberis umbellata, Wall.—Near Kangua on the Nepal side of the Káli Valley. A much more graceful plant than any of the varieties of *B. vulgaris*, which at first sight it resembles. The branches are more slender, the leaves less spiny, and the flowers are *subumbellate* on very long peduncles.

Myricaria germanica, Desv.—Rálam Valley near the glacier, 11-12,000 feet. Common also in Dárma and Byáns in the beds of streams.

Saurauja nepalensis, DC.—Tolerably abundant in East Kumaun at low elevations. Its time of flowering appears to vary a good deal; in the Forest Flora (page 25) it is said to be in flower about May; according to Strachey November is the time; in the Rámganga Valley I found it flowering in September.

Æsculus indica, Colebr.—Called *kishing* in Byáns.

Acer cæsium, Wall.—Called *kainshing* in Byáns.

A. villosum, Wall.—The Byáns name for this species is *tikainshing*.

Spondias mangifera, Pers.—Káli Valley near Cháchhum 2-3,000 feet.

Piptanthus nepalensis, D. Don.—Forests near Sosa, where it is called *biza*.

Caragana pygmæa, DC.—Abundant in Dárma and Byáns, forming in fact a large proportion of the vegetation in the drier alpine regions.

C. crassicaulis, Benth.—Plentiful in similar localities, but extending into less arid tracts.

Desmodium laburnifolium, DC.—Sarju Valley, 3-4,000 feet,

growing amongst boulders near the river. A local plant and not known west of Dehra Dún, where I found it two years ago in an exactly similar locality.

D. tiliæfolium, G. Don, var.—Leaves coriaceous, densely white tomentose beneath, leaflets broader and less acuminate than in the type. Abundant in the Káli Valley between Garbyáng and Budhi, 9-10,000 feet.

Dalbergia hircina, Ham.—Not uncommon by river sides at low elevations. The name *bakalpattia* was given to me for this tree besides that of *tantia*.

Prunus Padus, Linn.—Called *bombaksing* or *bombáli* in Byáns.

P. nepalensis, Ser.—Forest above Munshiári in the Gori Valley, where it is called *bang bhálu*.

Prinsepia utilis, Royle.—Known in Byáns under the name of *dentili*.

Spiræa sorbifolia, Linn.—Called *lusim* in the Kutti Yangti Valley.

Rubus alpestris, Blume.—Rather a tall straggling shrub with nearly glabrous foliage and large red fruit. In the hemlock spruce forest near Sosa, 9-10,000 feet. This is the only locality where I noticed the plant.

R. nutans, Wall.—A prostrate-growing bramble with large handsome white flowers and bright red fruit. Not uncommon in the forest region between 8 and 10,000 feet.

Rosa sericea, Lindl.—Abundant, especially in the drier parts of Dárma and Byáns. Called *chapalu* in Byáns; the same name is given to *R. macrophylla*.

Pyrus baccata, Linn.—(The Siberian Crab).—Called *rutripuli* in Byáns, where the fruit is eaten. Several trees were observed in the *chil* forests near Kangua on the Nepal side of the Káli river; elevation about 11,000 feet.

P. vestita, Wall.—The Byáns name for this tree is *naibel*.

P. Aucuparia, Gærtn.—In the birch forests near Shibu and in the Dhauli Valley. The berries are bright scarlet.

P. foliolosa, Wall.—Common in the birch forests. Called *martili* in Byáns.

Cotoneaster bacillaris, Wall.—Called *ticking* in Dárma, and *changma* in Byáns.

Hydrangea aspera, Don.—Near Sáma, 5-6,000 feet.

H. vestita, Wall.—Forest above Sosa, 10-11,000 feet.

Ribes Grossularia, Linn.—The wild gooseberry grows very luxuriantly in the drier parts of Dárma and Byáns. It is called *sirkuchi* or *baikunti* by the natives of these parts.

Viburnum cotinifolium, Don.—The Byáns name for this is *perálu*.

Lonicera rupicola, H. F. & T.—Plentiful in Byáns, forming near Kutti magnificent hedges between the cultivated fields.

L. spinosa, Jacquem.—In the drier parts of Byáns this species

is very common; so also are *L. myrtillus*, *L. obovata*, and *L. purpurascens* in damper localities in the forest region.

Pieris ovalifolia, Don.—Called *ydshing* in Byáns.

Rhododendron arboreum, Sm.—The Byáns name is *tofshing*.

Bassia butyracea, Roxb.—There are some fine specimens of this tree close to the village of Ganai near the Sarju Valley. The vegetable butter (*phulwa*) extracted from the seeds is a capital remedy for chapped hands and face, a complaint one is always liable to at high elevations.

Syringa Emodi, Wall.—The Byáns name for this is *tworsing*.

Solanum verbascifolium, Linn.—Called *ashera* in the Káli Valley.

Hippophæ salicifolia, Don.—Abundant in some of the valleys at an elevation of 8-10,000 feet, growing sometimes into moderate sized trees. The rough bark favours the growth of epiphytes, more especially ferns, and during the rainy season these trees often form remarkable objects of beauty. In Byáns the name *taruah chuk* was given to me for this plant.

H. rhamnoides, Linn.—Always at higher elevations than the preceding. Specimens were gathered in the Nipchang Valley on the Lebung Pass, and in the Kutti Yangti Valley in Byáns.

Arceuthobium sp.—A very curious little parasite belonging to the *Loranthaceæ*. It was found in considerable abundance on the branches of *Pinus excelsa* on the Nepal side of the Káli Valley between Kangua and Garbyáng at an elevation of 10-11,000 feet. This parasite at first sight appeared like bright green moss covering the smaller twigs of the pine trees which overhung the road. On examining it with a lens it was found to be mainly composed of minute flowers, male and female, the sexes being segregated on different parts of the branches. Mr. Brandis in the Forest Flora (p. 394) describes a species of *Arceuthobium* (*A. Oxycedri*, M. Bieb) discovered in Lahul as a parasite on *Juniperus excelsa*. The description there given determines the genus of the Nepalese plant, but I am inclined to think that it will prove to be a new species. The flowers are almost sessile, the female plants having a few more joints to the simple stems than those of the male, the flowers of which appear to be quite sessile. The perianth of the male flowers is 3-5-partite with valvate æstivation, the sessile anthers are attached near the centre of the perianth segments, and there is a small rudimentary ovary. The female flowers have a 2-partite perianth, supporting an ovoid ovary, very much resembling the sporange of a moss. The much reduced scale-like leaves are opposite, and with their edges combined at the base so as to form a sheath.

Loranthus ligustrinus, Wall.—Very common on *Machilus* and on several other trees between Askot and Almora.

Ficus trachycarpa, Miq.—Near Sáma at about 4,000 feet.

F. Cunia, Buch.—Called *kirmua* in East Kumaun.

Excœcaria acerifolia, F. Didrichs.—Abundant in the Sarju Valley near Kapkot. The Bhutias call the plant *básingh*, and use the leaves as a cure for rheumatism.

Jatropha Curcas, Linn.—A few plants were seen growing near a village in the Káli Valley at an elevation of 3,000 feet. The Nepalese name for this shrub is *shajun*. These plants, I was told, had been imported from Nepal.

Buxus sempervirens, Linn.—Called *shibsushin* in Byáns. I saw some fine specimens in the Káli Valley at an elevation of between 7 and 8,000 feet.

Quercus lanuginosa, Don.—Below Sosa at about 7,000 feet. Plentiful also between Askot and Dandihát from 4,500 to 5,500 feet.

Q. dilatata, Lindl.—Called *ramshing* in Byáns.

Q. annulata, Sm.—In the neighbourhood of the Rámganga and Sarju Valleys at an elevation of about 3,000 feet.

Castanopsis tribuloides, A. DC.—Between Askot and Karela in the Rámganga Valley growing with *Quercus lanuginosa* and *Q. incana*. The natives call it *katonj*.

Juglans regia, Linn.—This tree is called *kabsing* in Byáns.

Ephedra vulgaris, Rich.—Rálam, Nipchang, and Kutti Yangti Valleys from 11-15,000 feet.

Pinus excelsa, Wall.—Not a common tree in Kumaun; it is plentiful however in the Káli and Kutti Yangti Valleys, forming small forests between the villages of Nábbi and Garbyáng. In addition to the names *raisalla* and *lanshing* it has another in Byáns, viz., *durrasalla*.

Abies dumosa, Loudon.—There are some beautiful forests in the neighbourhood of Sosa in North-East Kumaun, which are mainly composed of this fine tree. The elevation is from 9-10,000 feet. The native name is *tangshing*.

A. Webbiana, Lindl.—Not uncommon in the Kutti Yangti and Káli Valleys between 11-12,000 feet. Called *wúman* or *wúnbusing* in Byáns.

Cupressus torulosa, Don.—Plentiful in the forests above Gini, where it is called raisalla, one of the names given to *Pinus excelsa*.

Juniperus communis, Linn.—Common in the Kutti Yangti and Káli Valleys. The Byáns names for this species are *chache* and *pates*.

J. Wallichiana, H. F. & T.—Extremely abundant in the drier parts of Byáns, often attaining to the highest limits of vegetation. Native names are *bhil* (Hind.), *shirchin* (Byáns), and *poh* (Tibet). Both Bhutias and Tibetans use the branches of this plant in their religious ceremonies.

Chamœrops Martiana, Wall.—A few specimens of this handsome palm were found in the forests above Gini. This palm, it appears, does not yield fruit annually, and no seeds were obtainable this year. It is called *tákhal* in East Kumaun.

Phœnix sylvestris, Roxb.—Common in the valleys at low elevations. Very abundant in a valley below Bininág associated with *chir* at an elevation of 3-4,000 feet. The interior portion of the young stems is eaten in times of scarcity. It is pure white with a firm brittle consistency, and having a flavour resembling that of the sweet chestnut. This palm is also known by the name *tákhal.*

Wallichia densiflora, Mart.—Plentiful in a damp ravine near Kinkola in the Káli Valley at an elevation of 2-3,000 feet: growing with the wild plantain, which latter has every appearance of being indigenous to the locality.

J. F. DUTHIE,

31st October, 1884. *Botanical Gardens, Saharanpur.*

SOUTH AFRICAN INDUSTRIAL EXHIBITION.

Cape Town, September, 1884.

THE specimens are surmounted by a rough Map of the Forests of Knysna, on which are stated the following information on the objects of Forestry, present conditions and forest prospects of the Colony :—

FOREST WORK AND MANAGEMENT.

Objects.—The forest regulations now in force have the following ends in view :—

1. To dispose annually of the quantity of timber which the forests can yield in perpetuity, so that each year the quantity felled may be replaced.

2. To assure the reproduction as quickly as possible of the best species on the parts cleared.

3. To open places for felling at distances as convenient as possible for wood-cutters who have formed locations within the forests.

Method adopted to attain the required end.—1. The forests are divided into blocks varying in extent from 200 to 800 morgen, according to the natural configuration of the country. Ravines, kloofs, ridges, &c., are taken advantage of to form boundaries.

2. Each block, or "series," of forest is divided into 20 sections.

3. These sections are opened successively, each for two years (all the others being closed), and then rest for a period of 38 years.

4. In each open section the matured, decaying, and surplus trees are marked for felling. They are numbered, measured, and registered, and are then available for purchase by the public on payment of license fees in advance.

Application of method :—Duties and work of officers for systematic management.—1. The work of each officer of the "higher grade" extends over a country of 5,000 to 15,000 morgen of forest land according to circumstances. The timber, or "high" forests, are surveyed by him. He determines the boundaries of series, and arranges the scheme of the formation of sections. Conservators issue such instructions in these operations as their long experience may dictate. These officers, after approval by the head of the department, open the lines, survey the sections, mark, count, and number the trees available for felling. They also survey the areas for re-planting, and direct all forest works requiring professional and scientific training.

2. A "forest guard" has charge of two or three series, and assists in survey operations, the opening of lines, and the marking of trees to be felled. He inspects all licenses, and sees that no unnecessary damage is caused in felling. He supervises his division, and carries out all forest work which his superior officer may direct in sowing, planting, the repair of roads, &c., &c.

Present condition.—The total forest area in the Knysna conservation is approximately 50,000 morgen. Of this about three-quarters has been more or less exhausted by reckless and indiscriminate felling. Despite this, 15 series have already been formed, in which 12 sections have been marked. The total number of timber trees marked for felling during 1884–85 is 20,000, containing 370,000 cubic feet (squared), and 25,000 poles and spars, the whole valued, at license rates, at £6,000.

Forest Prospects.—Future produce of the forests of Knysna.—These 50,000 morgen of forest land, even in their present condition, properly worked, will yield annually 1,200,000 cubic feet of timber, squared, valued at £15,000. The annual increment of forests, when properly managed, in other countries is, at the least, at the rate of 100 cubic feet per morgen. When the annual production of the forests of the Knysna reaches only 50 cubic feet their yield will be 2,500,000 cubic feet, value £30,000 per annum.

Organization and Staff necessary to ensure this production.—One conservator at Knysna, 3 officers of the higher grade, 24 forest guards, extra labour, and all various expenses. The cost of such an establishment would be £5,000 per annum. The conservation of Knysna is not yet completely organized. Those of King William's Town and Cape Town are still less advanced. In many districts of the colony, over which the Forest Department has not yet control, the best and most useful trees are being destroyed. The Transkei and Griqualand West may be instanced. If all forests of the colony were properly conserved, 10 conservators would be required, but the climate would be completely transformed, and a source of real wealth created.

The Exhibits comprise :—

1.—Specimens of Indigenous Woods.

2.—Bark, Charcoal, Wild Grapes, and Seeds used in Re-foresting.

3.—Maps and Pamphlets.

For full particulars see following descriptions of similar specimens sent to the International Forestry Exhibition, Edinburgh.

Descriptive Catalogue of Specimens prepared by the Forest Department of the Cape Colony for the International Forestry Exhibition at Edinburgh, 1884.

The Colony of the Cape of Good Hope extends from 28 degrees to 34 degrees latitude south, and from 18 degrees to 28 degrees longitude east, exceeding these limits but very slightly. Its area contains approximately 205,100 square miles. The surface of the country generally is broken, rising step by step from the sea-board to the interior by a series of mountain chains running in a direction east and west, and parallel to the coast.

At the present day all the large forests are included between the mountain ranges near the sea and the coast itself. There are patches of forest dotted over the southern slopes of the Outeniqua and Amatola mountains. Altogether the total area of the forest is estimated at about 100,000 morgen, and in many of them trees of large dimensions are still found, while day by day the opening up of new roads renders their exploitation less difficult. In four charts are shown :—

1st. The rainfall for the year in the different zones.

2nd. The rainfall during the winter.

3rd. The rainfall during the summer.

4th. The mean number of days of rain registered annually at the different observatories.

According to these charts, based on the mean observations up to the present time, there is a remarkable coincidence between the presence of forests and the annual quantity of rainfall. Whatever conclusion is drawn from it, the fact remains that copious rains and luxuriant forests are inseparable. Are we then to attribute the relative abundance of rain to the forests, or are we to look upon the presence of forests as a consequence of abundant rain? The following observation may, perhaps, help us to answer the question :—

Within the memory of man, all the forests which have disappeared have been destroyed by causes other than drought, notably by fires; and wherever forests have been destroyed, drought has followed. Take the climate of George Town as, perhaps, the best-known instance.

Less than 50 years ago, the whole mountain was wooded, the

forests extended from the mountain to within a short distance of the town, and its climate was considered much too damp; for rain fell nearly every day in summer. At the present time, and ever since the great fire in 1869, followed by other numerous fires,—parts of the district are, indeed, still wooded,—the large forests near the town have disappeared. The rainfall in 1882 was only 24 inches for 96 days of rain, which, judging by the complaints of the inhabitants, was a very inadequate supply. Here, then, we see the forests destroyed by other causes than drought, and drought following their destruction.

It is to be hoped that this colony will progress quickly and safely, and learn that forests mean moisture, and, in accordance with the law established in other countries, she will see a bountiful return of moisture when her mountains are re-clothed with forests.

Before the year 1883, the colonial forests were worked according to the regulations of 1875, which was a step in the right direction, and well worthy of serious consideration.

The regulations of 1883 are framed to arrest the destruction of the forests, and to commence their restoration.

Detailed instructions, theoretical and practical, are given to the staff charged with bringing about the reforms so much to be desired. The method to be observed in marking trees is fully described in special instructions.

The reports of the Superintendent of Woods and Forests for 1882 and 1883 show the progress made during these two years—that for 1883 contains on page 33 an example of a forest series, introduced in accordance with the new regulations.

The object of these remarks is to give a true idea of the position of the colony as regards forestry in connection with the exhibits in Class I.

The exhibits in Class II. are grouped according to the climate of the districts in which they grow. In reference to climate, the colony is divided into several very distinct zones.

1. The south-west extends from Cape Town to the Gamtoos River, and receives more rain during the winter than the summer; from a forester's point of view, it is characterised by the Stink-wood (*Oreodaphne bellata*—Nees ab E.) and Assegai-wood (*Curtisia faginea*—Ait.);

2. The south-east, on the contrary, has more rain during the summer season, and the forests in this division abound with Sneezewood (*Pteroxylon utile*—E. and Z.);

3. The west embraces the mountains, on which are still found specimens of Cedar trees (*Widdringtonia juniperoides*—Endl.);

4. The north comprises the borders of the Orange River, where the Cape Ebony (*Euclea pseudebenus*—E.M.) and Camel Thorn (*Acacia giraffa*—Wild.) are indigenous;

5. The central, in which the Doorn Boom (*Acacia horrida*—Wild.), Karreewood (*Rhus viminalis*—Vahl), and Witgatboom (*Capparis albitrunca*—Burch) are found. These, though not numerous, prove undeniably that forest trees will grow even in places most liable to drought.

The products of these five natural divisions have been grouped into three sections: the first comprises the rare woods of the north, the west, and the central zones, and those usually grown in the plantations; the second, the products of the forests in the south-west zone; and the third, those of the forests in the south-east zone. In most instances there are several specimens of wood for each species; and, as far as possible, a section showing the structure of the trunk, a plank cut in the direction of the medullary rays perpendicularly to the layers of growth. They are sufficiently large to show perfectly the quality, grain, and markings of the different kinds of wood, and the finish to which any work for which they were used might be brought.

The collection has been prepared with the assistance of all the officers of the Forest Department, of Prof. Peringuey, and of all the gentlemen who have contributed various specimens, amongst whom may be mentioned M. le Vicomte de Montmort, of Mariedahl, who has presented many specimens of woods long naturalised in the neighbourhood of the Cape.

(*To be continued*).

DEHRA DÚN FOREST SCHOOL.

THE indoor portion of the theoretical course of instruction at the Dehra Dún Forest School was closed on the 31st October, when the list of prize holders was read out by the Director.

The principal changes which have taken place since last year are a complete separation of the course of Morphological and Physiological Botany from that of Sylviculture, to which it formerly formed an introduction, combined with certain elementary teaching regarding soils and climates, which have now been relegated to the Natural History course.

Sylviculture is no longer taught in the lecture room, but in the forests of the School Circle by the Deputy Director, who has been freed from all executive forest work. Lectures on Utilisation and the elements of the Organization of Forests have also been added to the course, which will conclude in November-December with practical work in forest estimation and working-

plans in the Dehra Dún forests, and a visit to the Changa Manga and sailaba plantations near Lahore, and in the Pabbi reboisement works near Jhelum.

The junior students who during November and December learn practical surveying under Mr. Martin of the Forest Survey, and are working this year in the forests on the right bank of the Ganges river, will return to Dehra Dún early in January, and study sylviculture and utilization of forest produce in the Dehra Dún and Jaunsar Forests under Mr. Fernandez till the 1st July, when the indoor theoretical course will re-open.

The preparation of manuals for instruction at the Forest School is in progress, that on Sylviculture by Mr. Fernandez, on forest Vegetable Morphology and Physiology by Mr. Fisher, whilst Mr. Hearle, who teaches Systematic Botany to the second year students, has already published a pamphlet on Geographical Botany.

The study of Entomology, at the Dehra Dún Forest School, was specially provided for by the Secretary of State, and Mr. Clifford was selected from the Nancy students who had qualified in 1881 for employment in India, and after studying the subject specially under Professor Huxley and at the German Forest School at Tharandt, arrived at Dehra in December 1882.

A study of Entomology pure and simple has been considered too special for the Rangers' Class, and Mr. Clifford's course of lectures has been expanded so as to admit the study of all injuries and diseases incident to forest plants, whether by animals, insects or other plants, such as climbers, epiphytes, parasites or fungi, as well as the decay and preservation of timber; to this subject the title of Forest Etiology has been given, but it would probably be better to style it *Forest Protection*, corresponding to the German, *Waldschutz*, though this term may perhaps be considered too comprehensive in many respects, and does not properly include the preservation of wood and timber from decay.

The want of a general entomological museum in India for identifying species sent to the Forest School to be determined is greatly felt, and it is hoped that the Agricultural Department, which is at least equally interested with the Forest Department in this question, will take steps to supply this great want.

The American Commissioner of Agriculture has an Entomologist to assist him, and why should not India, which like the United States, is a great agricultural country, be similarly favored ?

Another addition to the course of instruction at the Forest School has been the opening of a Vernacular Class, in which instruction is given in Hindustani by the Deputy Director. This is as yet only in the experimental stage, and the men sent this year to attend the Vernacular Class are not been suffi-

ciently educated to profit much by what they hear. The fact is that, only the Central and North-West Provinces may be expected to send men to this class, as the Punjab has always plenty of candidates for the English course, and in other Provinces, Hindustani is not the vernacular.

Several men who have attended the School course have already been promoted to the grade of Sub-Assistant Conservator, of whom we may note—

1 in Ajmere.
1 in N.-W. Provinces and Oudh.
2 in Central Provinces.
1 in Assam.
2 in Bengal.
1 (probationary) in Burmah.

The number of students attending the School has been—

18 in Senior Class,
10 in Junior Class.
Three Forest officers of the superior staff, and an officer in the Canal Department, also attended a portion of the course.

One of the most promising features in connection with the Forest School, is the rising interest which the Native States of India are taking in it.

The following students from Native States have already been deputed to the Forest School :—

2 from Patiála.
1 ,, Kapurthala.
2 ,, Baroda.
4 ,, Jaipur.

Four men are also expected next year from Mysore and one from Rewah.

Madras thoroughly supports the School, and six men have already been sent from there to qualify for the Rangers' *certificate*, but the Bombay Government holds aloof, and sends its men for their training in forestry to the Poona College of Science, though it does not appear probable that they can have such good opportunities of obtaining practical instruction there as in the forests of the School Circle, with its specially trained staff of instructors and the cooperation of the Forest Survey Branch, the head-quarters of which are in Dehra.

Six men attended the Foresters' Vernacular Class, the instruction of which will be continued by the Deputy Director in the forest till July 1885.

The list of the marks obtained in the Final Examinations and of the prize-holders is given below :—

Second Year's Course, 1884.

Names.	Province.	Physiological Botany.	Road making and Building.	Physical Science.	Mathematics.	Surveying.	Forestry.	Systematic Botany.	Etiology.	Law.	Grand Total.
	Full marks,	300	40	720	720	600	900	720	360	360	4,720
a Tara Kishore Gupta, ..	Assam, ..	291	29	b 702	296	514	580	b 652	b 350	342	3,756
a Har Sarúp, (I.), ..	N.-W. P. School Circle,	230	32	647	b 581	350	b 762	557	294	342	3,745
Gokal Dás, ..	Punjab, ..	268	32	619	458	377	615	579	270	b 348	3,566
Thakúr Dás, ..	Punjab, ..	263	16	496	389	352	b 760	521	284	338	3,419
Ghulam Mahomed, ..	Punjab, ..	256	21	598	328	429	698	487	278	286	3,381
V. S. Guru Natha Pillai, ..	Madras, ..	239	37	553	514	449	467	484	304	310	3,357
Sada Nand, ..	N.-W. P. School Circle,	229	24	569	396	372	468	576	314	338	3,286
Narayan Prashad, ..	C. P., ..	258	29	595	355	388	460	505	306	330	3,226
Tinkauri Chaudhari, ..	Bengal, ..	212	†	469	288	525	627	541	220	184	3,066
Mansúkh Rai, ..	Punjab, ..	196	27	487	418	463	572	519	228	304	3,014
Rakhal Dás Mukerji, ..	Bengal, ..	213	21	494	234	306	707	512	178	342	3,007
Moung Shway Hka, ..	Burmah, ..	185	†	578	168	520	580	479	192	288	2,990
Jai Kishen, ..	Punjab, ..	271	21	571	206	377	488	492	262	288	2,971
*Atma Rám, ..	Punjab, ..	217	18	514	345	421	417	481	200	272	2,880
Moung Thakadoe, ..	Burmah, ..	150	†	517	58	522	619	307	280	294	2,793
* Goar Krishna Sarkár, ..	Bengal, ..	198	11	297	98	371	562	329	124	190	2,180
* Abdul Rahman, ..	Madras, ..	160	13	398	115	b 583	247	308	112	148	2,084
* Har Sarúp, (II.), ..	N.-W. P. School Circle,	158	16	308	282	331	188	199	174	208	1,804

* These men have failed to qualify for the Rangers' certificate. Differences of marks of less than 1 per cent. are not considered in precedence, or in awarding prizes.

† This subject was not taught in the first year's course for these men. Hence the grand total of full marks for them is 4,680.

a. These men divided the Director's prize for General Proficiency.

b. Prize holder in each subject.

Mr. Moir's prize for Forestry, ... { Har Sarup, I. / Thakúr Das. } *æq*:

Mr. Hearle's prize for best Herbarium, ... T. K. Gupta.

Mr. Chester's prize for best Essay on Natural Forest reproduction, ... } not yet adjudged.

Dr. Schlich's prize for best Note Book, ... } not yet adjudged.

The total value of the prizes distributed was Rs. 460, besides Rs. 70 for gymnastics, of which Rs. 50 was given by Mr. Broun.

Road-making and engineering was taught only in the first year, and hence the total number of marks appear inadequate, but this will be remedied in future years.

For the Junior students, Mr. Moir's prize for Botany was awarded to Keshavanand of the North-West Provinces School Circle, and the Government prize for Road-making and Building was divided by Keshavanand and Sundar Dás from the Punjab. Last year's prize for practical Forestry, which is offered by Mr. Fernandez, was assigned to Babu Jogeswar Súr and Mahadeorao Palnaitkar, who were equal.

We have heard that Divisional Forest Officers find great difficulty in sparing their men from their current duties so as to allow of their deputation to the Forest School, but this difficulty would surely be avoided, were Conservators to keep a small number of Forest Apprentices attached to the Direction, and were to post these men to the divisions to get practical experience of the forests before being sent to Dehra, or to replace temporarily Rangers and Foresters who could thus be deputed to the Forest School without much inconvenience to current work.

The memorandum of conditions of entrance and training of Students at the Forest School are given below for general reference.

Memorandum of Conditions for the admission and training of Students at the Forest School, Dehra Dún, dated the 3rd June, 1884.

Instruction at the Forest School, Dehra Dún, will be given in two courses—one in English for candidates for the Rangers' certificate, the other in Hindustani for candidates for the Foresters' certificate.

2. Candidates who desire to be received at the Forest School will be selected by the Director of the School, *or* by Conservators of Forests acting under such orders as may from time to time be given by the Local Government or Administration under which they are serving.

3. Students must, on admission to the School, be not less than 18 or more than 25 years of age. Exceptions from this rule require the previous sanction of the Government of India. Each candidate will be required to furnish a certificate of sound health, good vision and hearing, from the Civil Surgeon of the station nearest to his place of residence.

4. It will be the duty of the Conservator, or the Director of the School, to satisfy himself that the candidates have a good moral character, active habits, fair powers of observation, and sense of locality, and such other qualifications as are necessary for a Forest subordinate.

5. As a rule, no students will be received at the Forest School who have not proved their fitness for Forest work by service in the

subordinate staff of the Department, whether permanent or temporary, during a period of not less than twelve months.

6. Candidates for the Rangers' certificate must have passed the Entrance Examination of an Indian University. In the case of both an English and an Oriental side existing at any University, the Entrance Examination must have been passed on the English side. Candidates for the Forester's certificate must have passed the Middle Class Examination in the North-Western Provinces and Oudh, or an equivalent standard in other provinces, and they must possess a competent knowledge of Urdu or Hindi.

The condition of having passed these examinations may be dispensed with in the case of candidates who were in the Forest service on the 1st December, 1881, provided that the Director of the Forest School is satisfied that they have attained such a standard of general education as will enable them to follow the course of instruction with advantage.

7. Candidates selected for admission to the School will join at Dehra Dūn on the 25th June.

8. The course of training for the Rangers' certificate will extend over eighteen months, and that for the Foresters' certificate over twelve months.

9. During the course of instruction the Director will furnish Conservators of Forests periodically with reports on the application and progress of the students sent by them to the School.

The Director has power to dismiss any student for misconduct, and a student thus dismissed will not be re-admitted to the School. The Director may also remand to his province or circle any student who, in his opinion, is not sufficiently promising.

10. Successful students will, at the close of the course of instruction, receive a Rangers' or Foresters' certificate. Students of special merit may be granted certificates with honours. Students of the Rangers' class who fail to obtain the Rangers' certificate may be granted the Foresters' certificate. Those who have obtained the Rangers' certificate may, on return to their province or circle, be appointed to the class of Ranger. The students who have obtained the Foresters' certificate must serve satisfactorily as Foresters for at least two years after their return from the School before they are considered qualified for promotion to the class of Ranger.

11. No person who has not qualified in the manner here prescribed shall be appointed a Ranger without the special sanction in each case of the Local Government.

12. Candidates from Native States and others will apply, either direct or through the officers under whom they are serving, to the Director, who will deal with their application for admission to the School, as far as practicable, in accordance with the above provisions.

There are a few scholarships of Rs. 20 per mensem at the disposal of the Director of the Forest School, and as the men deputed from the various provinces are fully provided for during their stay in Dehra, these will generally be granted to deserving private students, who are appointed by the Director and attached to no particular province.

DEODAR PLANTING.

As an old Forest Officer, and one who has done a great deal of deodar planting, I trust I may be excused if I say a few words about the system adopted in Kulu, and described at page 466 of your Number for October. I quite agree with the employment of boys, I have always found them much quicker in learning and smarter in planting than either men or women; but as regards the Kulu method, I am sorry to say I cannot see the use of it, and think it must certainly be much more expensive and slower in execution than the system of planting in holes. In the first place I have always found that young deodar of 20 months old are quite strong enough to be planted out, they are then 9 inches high (if below that I never put them out), and I see no use in keeping them in the nursery another year; this however, is a fault on the right side; the parts of the Kulu method to which I would take exception are, the trench and the number of plants used. Of course, lines must be cut through the jungle, otherwise no planting could be done. I therefore pass on, merely remarking that in my opinion 10 feet between the lines is too far. Deodar should be planted in lines not over 5 feet apart; there is no doubt they thrive better and throw out less branches when they are grown close together, and as they are found in dense thickets growing naturally, we can do no harm in this case in following nature. As regards the small trenches made in Kulu, it appears to me that they must be at least four times as expensive as holes, and as four plants are put in a space of 2 feet, it stands to reason that there is a waste of three plants, for it is impossible for four *trees* to exist 6 inches apart. I hold that as it is quite possible to plant deodars in holes 5 feet apart without 10 per cent. of loss, it is therefore sheer waste of material, time and money, to dig small trenches 2 feet long and put four plants within the 2 feet. As for the little dab of mud to stick the plant against the wall, I see no harm in it at all. I am sure many officers must have seen continuous lines of deodar, planted simultaneously, as in the Kalatóp Forest near Dalhousie; as therefore, it is possible to plant successfully at 5 feet apart in holes, I cannot see the use of an expensive trench and the waste of three plants. When I planted deodar in former years (and I have done it with less than 10 per cent. of loss), I worked as follows:—Lines were cut through the jungle, where necessary, at about 5 feet apart, then men with "pharwas" cut deeply into the soil three or four times at points 5 feet apart in the lines, whilst after them came boys or men with "khurpas," who dug the hole to the required depth, leaving the loose soil on the lower side; this was done some days or even weeks before the actual planting took place. Planting was done by boys who had been carefully trained to the work; the plant was held at the

required height above the bottom of the hole, so that the end of the root was not bent or curled upwards, this was then fixed in the earth with a lump of mud, and loose soil from above the hole gently crumbled about the roots and gradually pressed down all round. I consider this plan far simpler than the Kulu one, less expensive, and one that does not require such careful supervision, all of which are of great importance to a Forest officer who cannot always be present when planting is going on. There is really no more difficulty in planting a deodar than in planting a cabbage, the principal things required are that the root shall not be injured in taking out of the nursery, and shall be fixed properly in the earth when planted out. To conclude, I have no doubt the Kulu method gives excellent results, but I maintain that it is a tedious and expensive one, and as long as single plants can be successfully planted out at 5 feet apart in holes, it is quite unnecessary and wasteful to put four plants in a space of 2 feet, seeing that at some time or other three of them *must* be lost.

G. SPARLING,
retired, Deputy Conservator of Forests,
late of Jhelum Forest Division.

DALHOUSIE :
31st October, 1884.

OFFICIATING APPOINTMENTS.

WILL any one tell me what are the rules about officiating appointments in the case of a man going on privilege leave. There seems to be an impression, that privilege leave gives no officiating appointments, on the theory that Government is not to be any loser in such cases. The remainder of the establishment must carry on the work, but there is to be no extra cost to Government.

Yet we had a case the other day of a 1st grade Deputy Conservator taking three months privilege leave, and the vacancy was filled up by officiating appointments just as in the case of furlough. Cannot other provinces do as Bengal? And is the Forest Department under different rules, in such cases, to other Departments?

SCARABI.

Note.—The grant of privilege leave on the theory that Government is not to be any loser in such cases, is only restricted to the case of an officer whose pay is less than Rs. 100, sec. 127 of the Civil Leave Code, which lays down that "Leave may be granted to an officer, whether he be in Superior or Inferior "Service, whose pay is less than Rs. 100, so far as it can be done without imposing any cost upon the State, &c., &c."

But it does not preclude the appointment of another officer for the time: Rule 2, sec. 76 of the Civil Leave Code, lays down as follows:—

"An officer on privilege leave is entitled to leave allowances equal to his "salary, even though another officer be appointed to act for him."

Again, sec. 5 of Pay and Acting Allowance Code provides that—

"No *acting* allowance is given to an officer acting in a higher appointment in consequence of the absence of another officer on privilege leave, for the first 30 days of such leave, unless the acting officer is transferred from another station, in which case he may draw three-fourths of the acting allowance otherwise admissible."

And Rule I. under the section states that—

"As a general rule, the duties of an officer absent on privilege leave should be discharged by another officer at the same station. Only in exceptional cases, where there is absolutely no officer available on the spot can the deputation of an officer from another station to act, in consequence of the absence of an officer on privilege leave, be allowed."

It will be thus seen that though there is no direct provision as to the disposal of the officiating appointments in a higher grade, vacant consequent on the substantive holder in an appointment going on privilege leave, yet there is nothing against *officiating* appointments consequent thereon. But the case is optional with the Local Governments, and there is nothing in the Civil Leave Code, or Acting Allowance Code, special for Bengal which does not apply to any other province.—[ED.]

FLOWERING OF MANGO TREES.

ADVERTING to the question of second flowering of mango trees raised in your October Number of the "Indian Forester," the following account may, perhaps, be worth the while of your readers.

The second flowering of the mango tree in the winter does not seem to be a singular phenomenon, but one of general occurrence, though confined to a small number of trees, and is more or less a habit with them. It is very common in the Southern Presidency, and is generally known as *Kar kai* in Tamil (mango pertaining to the Tamil calendar month of *Karthigai*, corresponding to English November or thereabouts), and the people naturally expect it at this season of the year. I cannot speak with authority as to the fruit being abortive or otherwise, but the mango is none the worse for its being *out of season*, certainly not in Madras, as it is universally known that there is a season for winter mangoes.

It may be well to note here, that one of the mango trees, by no means of the best species, in the small garden attached to the Madras Forest office, flowered unlike the rest, at an unseasonable time this winter, and after the flowers had become developed into small mangoes, they looked blasted, and bunches of small rotten mangoes, quite black, are still observed on the trees. This last is perhaps owing to the late heavy rains that have set in? An old gardener of nearly three score and ten tells me that he has known this tree to yield a second crop for the last fifty years and more, and adds that it also produces good fruit.

MADRAS:
20th November, 1884.

A. R.

III. OFFICIAL PAPER.

REPORT ON THE BOX-WOOD SUPPLY IN THE PUNJAB.

THE box-wood tree (*Buxus sempervirens*) is found in the Punjab in the following localities:—

Bashahr Division—

Neogli Range, on the Neogli River.
Pindrabis Range on the Gunagad.
on the Kenchagad.
on the Wangar.
Tranda Range, at Nachar.
at Panwigad.
Kilba do. from Panwi to Punang (left bank).
from Punang to Sholtu.

Beas Division—

(Kulu)
Janga Kootka forest.
Gran Nal "
Bitu Kanda "
Ladag "
Tiker "

Chamba Division—

(State forests unreserved).
Bhiani Nalla.
Valley of Suil Duir Ilaqa.

Jhelum Division—

(Shahpur Salt Range) Khusab rakhs.

Rawalpindi Division—

Margala and Khairi Murat reserves.

The total area known at present which is covered with box-wood, is estimated at 1,387 acres, as follows:—

Rawalpindi Division, ...	500 acres.
On this area, box only forms $\frac{1}{10}$th of the vegetation, rarely occurs pure, and then only in patches of a few square yards.	
Beas Division, ...	50 "
Bashahr Division, ...	820 "

This area is made up in the greatest part by the three following forests:—

Morul, ...	211 acres.
Kashapat, ...	164 "
Kunalung, ...	365 "

In all three areas, box is plentiful, 37 acres of Morul and 21 acres of Kashapat being a pure and dense forest.

Chamba Division.—It grows on only 17 acres, but of these 15 acres is nearly a pure forest.

Jhelum Division.—The box-wood here is scattered in small patches all over the Khusab rakhs and forms no continuous area.

The forests in which the box-tree is found differ most widely in elevation, climate and soil.

In the Margala reserve, the tree grows at an elevation of from 2,000 to 3,000 feet; in the Shahpur Salt Range, from 3,500 to 4,000; in the Bhiani Nalla in Chamba, at about 6,500; in Kulu, at about 7,500; and in Bashahr, at an elevation of from 6,000 to 8,000 feet.

Again in Margalla, it grows on decomposed triassic limestone; in the Salt Range, on a sandstone formation; in Bashahr, on sandy beds formed of decomposed clay, slate and gneiss; and in Chamba, on a rich vegetable mould overlying mica schist.

The tree is, however, constant in one respect as regards its habitat, and thrives in moist and sheltered places, hugging the alluvial deposits along the banks of perennial streams, and it does not thrive where it is exposed to winds, may they be hot and dry, or cold and frosty. It also avoids the hot sides of the valley, and evidently prefers a north-west and northerly aspect.

The *sine quâ non* for its growth, are moisture and shelter, and though the tree grows in the Shahpur Salt Range, where the rainfall is small, and the daily ranges of temperature and the seasons are extreme, it only attains the proportions of a shrub, and its large distribution over this area is at present of no commercial value, but is to me a certain proof that the Salt Range was once well wooded, and could boast of a very much better climate and vegetation, of which the box bushes are a remnant.

The leaves of Salt Range box have a rush-coloured tint instead of the dark chrome green, in more favourable localities. In the Margalla reserve, the trees are somewhat better, but they reach perfection only in Bashahr, especially on the Neogli river, where they attain a girth of 4 feet, and with a height of 30 feet, grow clean boles from 10 to 15 feet in height.

The annual growth in the Bashahr forests is also much superior to the increase in any other part of the Province, and countings of annual rings, which, however, have not been very numerous, show an average of 18 rings per inch radius in Bashahr, against 28 rings in Chamba, 30 in Kulu, and from 30 to 40 in Rawalpindi. According to these figures, it would take 72 years in Bashahr, 112 in Chamba, 120 in Kulu, and 120 to 140 years in Rawalpindi, to grow a first class workable tree of 24 inches girth.

As stated in para. 3, the box-wood growing area is estimated

at 1,387 acres, of which, however, only a very small area contains pure box forests. As a rule the tree is found intermixed with horse-chestnut, maple, hazel and walnut, and being a much slower grower than any of these trees, it is mostly suppressed.

It is consequently very natural that the tree grows quicker and to finer dimensions in pure forests.

The mature stock at present on the ground has been counted, and amounts to 7,707 trees above 2 feet in girth, which are distributed as follows :—

Bashahr, ...	7,047
Beas (Kulu), ...	520
Chamba, ...	140

Besides this, a growing stock has been enumerated of 16,851 young trees in the Bashahr forests, and of 600 in Chamba.

From the Rawalpindi Division, it is reported that nearly all trees over 4 inches diameter are rotten in the centre.

In the Bashahr Division, natural reproduction in pure forests is all that can be desired, and all that is required is to cut out the mature timber and to close the forest against the grazing of goats. In mixed forests, the reproduction has been prevented by the dominant trees, the box bearing no seed under the dense shade.

The natural reproduction in the small area found in Chamba is reported satisfactory ; in Kulu, as only fairly good, and very poor in Rawalpindi.

With regard to the commercial value of the forests, the cost of extraction has first to be taken into consideration, which, per ton, amounts to, in the—

			Rs.
Bashahr Division	to	Phillour, ...	131
	"	Umballa, ...	132
Beas	"	Amritsar, ...	125
Chamba	"	Pathankote, ...	147
Rawalpindi	"	Rawalpindi, ...	7
Jhelum	"	Bhera, ...	13

Next we have to consider the local value, and the following are the prices, as far as can be ascertained, obtainable in local markets :—

Rawalpindi,	Rs. 6	per maund, or	Rs. 168 per ton.
Amritsar,	" 5 to Rs. 7	"	" 140 to Rs. 196 per ton.
Simla,	" 7	"	" 196 per ton.
Jhelum,	" 4	"	" 112 "

About Rs. 3,000 worth of box-wood is bought annually in Amritsar.

The export prices quoted, are £24 per ton weight landed in London.

From experiments made in the Bashahr Division, the green wood gives 28·64 cubic feet per ton. Now in the Kashapat

and Morul forests alone the cubical contents of mature trees have been reckoned at 28699·1 *cubic feet*, of which 20030·6 is first class and 8668·5 is second class: the lower half of tree being taken as first class, and the remainder as second class.

Thus then from these forests we can obtain a present stock of 1,001 tons,—699 tons 1st class, and 302 tons 2nd class.

I have heard that a consignment of box-wood made by the School Circle, North-West Provinces to Churchill and Sims, London, cost for carriage to London (including agency charges) *viâ* Karachi from Saharanpur, at the rate of Rs. 3-6-1 per maund, or Rs. 94-10-4 per ton.

The cost in carriage between Saharanpur and Umballa is Re. 0-1-9 per maund, deducting this from the above, I find that box-wood from Bashahr could be landed in London at Rs. 91-9-4 + Rs. 132 (carriage to Umballa)=Rs. 224 per ton. Taking the exchange at *1s. 7¾d.*, this is an expense of £18 *8s. 8d.* per ton for the box-wood consigned to London.

The price quoted at home is £24 per ton weight.

It will thus be seen that by exporting the first class wood we will realize, it is estimated, a net profit of Rs. 75 per ton, or Rs. 35 above the price which it would fetch in the local market.

The net value of the Bashahr box forests, which are the only ones that need be taken into consideration as regards immediate exploitation is therefore—

		Rs.
700 tons, at Rs. 75 profit,	...	= 52,500
300 " " 25 "	...	= 7,500
	Total, ...	60,000

I roughly estimate that with strict protection and the gradual thinning out of dominant trees of other kinds, the present growing stock will replace the mature stock in 24 years, in which time the present mature timber may be extracted, reproduction being insured at the same time.

It will not, of course, be possible to secure an annually recurring out-turn, for the difficulties as regards working are against this; and I propose that the forests should be exploited in four cuttings in 1884-85, in 1891-92, 1899-1900, and 1906-1907.

As regards the box-wood forests in the other Divisions, I can as yet only recommend their strict protection and, if necessary, fencing. In the meantime, experiments with regard to artificial reproduction of box have been instituted in all the Forest Divisions concerned.

BERTH. RIBBENTROP.

V. Notes, Queries and Extracts.

THE ASIATIC ELEPHANT IN FREEDOM AND CAPTIVITY.

(*Continued from Vol. X., page 582.*)

The elephants usually give some little trouble for the first two nights, but their conservative nature then seems to lead them to believe that there are set bounds to their wanderings; and unless fodder or water becomes scarce, they seldom try to force the guards. A small herd always gives more trouble than a large one. The former may only be a wandering party from some large body of elephants not far away; it then shows a strong desire to break through to join its companions. A small herd, too, probably has no calves with it, which is a great disadvantage, as it is then restless and quick in its movements. And a herd of a dozen elephants or so may be well in command of one courageous leader; whereas, in a large gathering, timid animals preponderate so greatly that a panic is easily established, and elephants that might otherwise behave boldly become infected with the general fear.

One or two of the males of a herd frequently pass in and out of a circle; and I have known several cases in which a portion of a herd has been absent when their companions were surrounded, and has been admitted by the guards by withdrawing at the point where it wished to pass in. Sometimes, but not often, men are killed at their posts by the elephants.

On the day following the investment of the herd, the construction of the kheddah, or small enclosure into which the elephants are to be driven, is commenced. It is situated on one of their chief paths (within the circle), and is constructed with the trunks of young trees, about 6 inches in diameter, and 12 feet high, arranged in a circle of from 20 to 50 yards across. Inside, round the foot of the palisades, a trench 6 feet wide and 4 feet deep is dug, the earth from this being thrown up into a bank on the inner side. The trench and bank of loose earth usually deter elephants from attacking the stockade, or should they do so, prevent their employing their full force against it. The palisades are lashed together with canes, and are strongly supported by cross beams and forked supports behind, the whole structure being designed to support outward pressure only.

Were elephants to pull the palisades inwards, they would yield at once, but they never use their trunks for this purpose. An entrance of 4 yards in width is left for the ingress of the herd, and a gate, studded inside with sharp spikes, is either slung from the trees overhead, or is made in two leaves, and is pushed to upon the entrance of the herd by men stationed behind it.

A stockade of 40 yards in diameter accommodates 100 elephants easily. To guide the elephants into it, two lines of strong palisades are run out from the gate along each side of the path by which the herd is to approach. These guiding wings diverge to perhaps 60 yards across at their commencement, which may be 100 yards or so from the gate. When the whole is completed, the new woodwork is hidden with leaves and branches. The stockade is usually completed in three or four days. The hunters consider Friday the most lucky day for driving, and they make extraordinary efforts to get the stockade ready by that day if possible. The work of the stockade is done by one-half the hunters being taken from the large circle from morning till evening daily, as a weak cordon of guards suffices to keep the elephants in during the day.

All being in readiness for driving, a number of men are taken from the original circle, and a smaller interior surround is formed by commencing at the guiding wings of the kheddah, and posting the men until the elephants are again closed. The original circle is, of course, still maintained, in case of the elephants breaking through the inner one. If the herd be in two or three detachments, as frequently happens, these are quietly driven together, and the whole are then moved forward towards the kheddah. Should they show an inclination to break to the right or left, the men deter them by striking their axes against the trees. When the elephants gain the funnel-shaped approach to the stockade, the men close in from behind, and from the sides, and urge them on with shots and shouts. If the herd suspects danger, and breaks back through the beaters, fatal accidents not uncommonly occur. Sometimes a herd declines altogether to go in the direction of the stockade, owing to their having the wind from that quarter. In such a case a new stockade may have to be constructed, and if that does not succeed, others also. In this way elephants are sometimes kept in a surround for a month.

Supposing the herd to have been got within the wings near the gate, a line of dry grass and bamboos arranged beforehand is fired, and their retreat is cut off. They then sometimes attack the guiding palisades, but men with spears and muskets receive them here. I have seen two cases in which the elephants forced the palisades, and killed men behind them. Tame elephants are used, if possible, to assist at this stage of driving, chiefly as a protection to the men on foot, who run behind them should any elephant turn and charge. There is much less danger of this

occurring in dealing with large herds than with small ones, as should a single elephant charge out of a large herd, it is rarely supported, and it quickly rejoins its companions. But a determined leader of a handful of elephants is liable to be followed at once by the rest. When an elephant chases the men, they betake themselves to the shelter of tree trunks, bamboo clumps, or long grass, and it is astonishing how they frequently escape uninjured. I have known many cases of men standing against a tree, or hiding in tufts of long grass, within a couple of yards of elephants that were pausing in indecision, without being discovered, though the elephants were evidently aware of their close proximity, as they kicked up the ground in anger, and then made off. In such cases the slightest movement would have led to the hunters being instantly trampled to death. Men are frequently killed, of course, but they are almost always young hands who are learning. I saw one such make a narrow escape a few years ago; he ran from an elephant and climbed a tree; the elephant butted the trunk, and the man fell down, but his pursuer was so astonished at the sight that she fled at once.

Sometimes drives are conducted by torchlight, and these seldom fail, owing to the elephant's fear of fire. The scenes on these occasions are exciting beyond description. The elephants in rushing along tear down large branches of trees that are connected with the undergrowth by climbing-plants, and even sometimes upset dry trees bodily in their passage. The cries of the young, and the deep, thunder-like growls of the elders of the herd, the continued crashing of the jungle, and the shots and incessant cries of the men, form, with the unnatural light of the fires and of torches moving through the forest paths, a scene that cannot fade from the memory of anyone who has witnessed it.

When a herd has been driven into the stockade, the gate is closed and barricaded, and men with firebrands and spears repel any attacks upon it or the palisades. But the trench is usually sufficient to deter the elephants from crossing it. On the same or following day, ten or twelve tame elephants are admitted with a mahout and rope-tier upon each, and it is a very remarkable fact that the wild ones very rarely attempt to dislodge the riders, as they easily might. They naturally fail to comprehend anything so foreign to their experience as a man upon an elephant's back. I never knew a case, except one that happened to myself, of any rider being attacked by a wild elephant. The mahouts separate the wild elephants one by one from their companions, when their hind legs are tied by men who slip to the ground for the purpose. A rope is then secured round each captive's neck, and to its hind legs, and it is led out and picketed in the forest near.

If two well matched rival tuskers happen to be impounded in

one stockade, they sometimes fight to death, seemingly regardless of their novel position. If not well matched, the more powerful one bullies the weaker one incessantly. On one occasion, when a herd of forty-eight elephants had been impounded, a scene of this kind occurred, one elephant following and fighting with another almost continuously for two days and nights. The smaller elephant retaliated on others weaker than himself, and between them the pair killed four young elephants and a large *makhna*. They caused such commotion that the tame elephants could not be admitted. At last the larger tusker forced the smaller one across the trench, and against the palisades. The latter commenced to break his way out; and though muskets were fired into his face, and spears and digging tools made red-hot for the occasion, were applied to his trunk and head, the inducement behind was so strong that the counter efforts of the men were unavailing, and he made his way through the palisade, and went off into the jungle. This was at 2 A.M., and was a sufficiently exciting scene. *No other elephants attempted to* follow, and the gap was quickly repaired.

Amongst these forty-eight elephants was one that had escaped about twelve years ago, judging from the ages of her three calves. We first observed the fact of her being an escaped elephant by seeing old rope marks on her legs. When the tame elephants entered the stockade, two ranged alongside this one, and on being pricked with a spear, and hold to kneel, she obeyed at once. She was ridden alone a few days afterwards.

The number of wild elephants that can be taken care of is, at the most, 50 per cent. more than the tame ones. As each capture is concluded, the wild elephants are marched out of the jungle into open country, for if kept in the forest they continue *to be excited by jungle sights* and sounds, and to struggle for liberty, whilst flies are much more troublesome to their wounds in the jungle than in the plains. Each batch of new elephants requires a number of tame ones to be detached in charge of it; thus the hunting operations are limited by the number of the latter.

When a sufficient number of elephants has been taken, the hunters are dismissed, and all elephants under 7 feet in height are sold to merchants who follow the kheddah parties for the purpose of purchasing such. Those above 7 feet are retained for Government service, except some males and old females which are also disposed of. Not more than 30 per cent. of the elephants captured are young and strong females, thoroughly suitable for Government service. The selected wild elephants are now divided into gangs of twenties, with a proportion of tame ones in charge. These escort the wild ones, bring their fodder, and lead them to water daily. The march from the jungle commences about the end of February, and the elephants reach the depôt at Dacca in May. They are then put

into training, and by November are quite steady, and are drafted for military service.

New elephants are trained as follows:—They are first tied between two trees, and are rubbed down by a number of men with long bamboos, to an accompaniment of the most extravagant eulogies of the animal, sung and shouted at it at the top of their voices. The animal, of course, lashes out furiously at first; but in a few days it ceases to act on the offensive, or, as native say, "*Shurum lugta hai,*" "It becomes ashamed of itself," and it then stands with its trunk curled up, shrinking from the men. Ropes are now tied round its body, and it is mounted at its picket for several days. It is then taken out for exercise, secured between two tame elephants. The ropes still remain round its body to enable the mahout to hold on should the elephant try to shake him off. A man precedes it with a spear to teach it to halt when ordered to do so; whilst as the tame elephants wheel to the right or left the mahout presses its neck with his knees, and taps it on the head with a small stick, to train it to turn in the required direction. To teach an elephant to kneel, it is taken into water five feet deep when the sun is hot, and upon being pricked on the back with a pointed stick it soon lies down, partly to avoid the pain, partly from inclination for a bath. By taking it into shallow water daily, it is soon taught to kneel even on land.

Elephants are taught to pick up anything from the ground by a rope, with a piece of wood attached, being dangled over their foreheads, near to the ground. The wood strikes against their trunk and forefeet, and to avoid the discomfort the elephant soon takes it in his trunk, and carries it. It eventually learns to do this without a rope being attached to the object.

I have only time to add a few facts regarding the financial results of elephant catching by the Government establishment at Dacca. Referring only to the official year ended 31st March, 1883, the expenditure upon the hunting establishment for twelve months was *£12,948, and the receipts by surplus elephants sold, and the value of those retained, £19,492, showing a profit of £6,544. Of this amount, £4,000 was surplus from the preceding year.

During the past five years the annual average number of elephants captured during our short working season, from December to February, has been 154. The greatest number in any single year was 252 in seven weeks in 1882, and 199 in a similar period in 1883. A ready sale is effected amongst the native landowners, and others who are fond of keeping elephants, of all those not required by Government.

The belief that wild elephants have decreased in India is not an uncommon one, and may have arisen from the fact of laws

* Taking the Rupee at 2*s*. for convenience.

having been passed in late years for their protection. Also, from their undoubted decrease some years ago in Ceylon. But the case of that island is not analogous to that of the continent. In Ceylon, elephants have always been made a peculiar object of pursuit by large numbers of sportsmen, and by paid native hunters, whilst their range is not without its limits. To show the numbers that have been destroyed there, I may quote the official statistics between 1845 and 1859, which show that during those fifteen years rewards were paid for 5,194 elephants killed in, I believe, only a part of the island. Similar destruction has gone on for years, until rewards were abolished some years ago. But elephants are again becoming numerous, and are again allowed to be shot.

But on the Continent of India the number shot by European sportsmen has always been small, and it was only for a few years that natives were induced to turn their attention to killing them by a reward given for their destruction in the Madras Presidency. This was soon withdrawn, and the representations of humane officials having further led to the curtailment of the wasteful methods of trapping them practised by native hunters, the wild elephant now enjoys perfect immunity throughout the Western Ghâts, and those boundless forests extending for hundreds of miles along the foot of the Himalayas into Burmah and Siam. The number annually caught by the Government hunting establishment at Dacca (the only one at present in India), and by licensed native hunters, is, comparatively speaking, very small; and there is no doubt that all the forest ground that can be legitimately allowed to the wild elephant is as fully occupied at present as is desirable. The elephant-catching records of the past fifty years attest the fact that there is no diminution in the numbers now obtained in Bengal, whilst in Southern India elephants have become so numerous of late years that they are annually appearing in places where they had never been heard of before.

In the Billigarungun Hills, an isolated range of 800 square miles on the borders of Mysore, wild elephants first made their appearance about the beginning of this century, having strayed from the forests at the foot of the Neilgherry range, across an intervening strip of some thirty miles of civilised country. Prior to that time the Sholagas, a wild tribe that inhabit the Billigarungun hills, but which has now dwindled down to a handful of savages, were a numerous people; traces of their former extensive cultivation, even of orange groves, gardens, and iron-smelting furnaces, still exist, together with lakes on the summit of the hills, for the convenience of the cattle which used to be driven thither from the neighbouring low country for pasturage during the hot weather. The Sholagas were almost destroyed by three successive visitations of small-pox, a disease which is always exceedingly fatal amongst hill people in India;

their lands relapsed into the densest forest; and wild elephants and bison now abound where probably not one was to be found a century ago. The case of these hills is an interesting instance of a large tract of country in India having relapsed into a wilderness in recent times.

To give an idea of the numbers of wild elephants in some forests, I may say that during the past five years, between 1878 and 1883, 1,066 wild elephants have been captured by the Dacca hunting establishment in a tract of country about fifty miles long by twenty miles broad, in the Garo-hills in Assam, whilst fully as many more were met with during the hunting operations. Of course these elephants do not confine themselves to that tract alone, but wander into other parts of the hills. There are immense tracts of forest in India similarly well-stocked with wild elephants.

I am sure it will be regarded as a matter for hearty congratulation by all, that so grand, interesting, useful, and harmless an animal as is the elephant is in no danger of becoming extinct in India. Though small portions of its haunts have been cleared for tea or coffee cultivation, the present forest area of the country will, probably, never be practically reduced, for reasons connected with the timber supply and climate; and as long as its haunts remain, the elephant must flourish under due regulations for its protection.

(*To be continued*).

EARLY HISTORY OF FORESTRY.—Forestry as a science is of a comparatively modern date. In primeval times, the surface of the globe was covered with dense forests, and the clearing of them was the first occupation of the human race. Take, for instance, India; the production of her jungles found their way into the commerce of antiquity long before she was ever known by name. The spices used throughout Egypt, Syria, and the adjacent countries, must have been supplied from here. Recent explorations in the ruins of Nineveh and Babylon have shown that the wood employed in the building of the temples was Indian teak. With the descent of the Aryans into the plains of Central and South-East Asia, they were as a matter of course deforested, but there still remained large patches of the country covered with dense vegetation which the Aryan conquerers could not penetrate. It was the same in Europe. The annals of Tacitus give us an insight into the nature of the land where thousands of the Roman soldiery found their graves in the impenetrable mountain fastnesses of Germany, and the mournful exclamation of the Emperor Augutus, which was ever on his lips, whether awake or asleep, "Varus, restore to me my legions," can help us in forming an idea of the masses of vegetation which covered Europe, and ingulphed the flower of Roman chivalry. An indiscriminate clearance of these obstructions,

with the advance of civilization, was an actual necessity in those days, but with the gradual destruction of forests, came the necessity of preserving such portions of them as would contribute to the well-being of society. The rules and regulations relating to forestry may be traced back to the dark ages of European history; but forestry conducted on scientific principles was unknown on the Continent till the middle of the 17th century, and the first glimpse we get at the forest economy of France is in 1660, before the issuing of the famous Code of 1669. The following account given by a Spanish writer, which he had prepared in accordance with orders received from the higher authorities of the State, will be found very interesting :—

"In the seventeenth century originated in some of the States of *Germany the application of technical science to the treatment of forest masses.* The rules, the aphorisms, and the whole of the directions which are comprised in the forestal knowledge of the ancients, are principles indefinite, obscure, uncertain, unconnected, destitute of method or systematized relations. Moser created in 1757 the first body of systematic teaching on the subject; and to the impulse given to this by him, and the weighty energy of Langen, Laspar, Zanthier, and others, are we indebted for the formation of the first plans of scientific treatment of forests begun in 1731 in the forests of the Dukedom of Brunswick. He, in his time, Langen being the first to do so, perceiving the necessity of entrusting the management of the forests to a *specially educated and trained body of officials, possessing* all necessary knowledge and information, with a view to raising up a body of such men, established the first school of forestry in Wernigerode in the year 1772. But others consider the first School that founded by Zanthier in Ilsenberg, which was followed some years later by the establishment of that by Haase in Lauterberg, that which G. Hartig founded in Hungen in 1791, that in Zillbach by H. Cotta in 1795, and various others, all due to the efforts of individuals, and manifesting that essentially practical character, which was so requisite to meet the requirements of the time and the conditions in which the distinguished founders were placed, but devoid of means which would allow of there being given to them the influence and development which became needful.

"Contemporaneously with the schools there were produced also methods, or systems, of exploitation; and the names which have been cited are those of men who proved authorities of the highest rank, who have opened up new paths in forest study. For me it is impossible, nor does space permit, to produce a chronological and critical narrative of the principal phases through which the newborn forest science passed in its evolution and successive development; fresh in the memory of many in Spain must be the remarkable articles written under the title, 'Sistemas Forestales,' of the erudite forest engineer, his Excellency Snr. D. Agustin Pascual, the first Spanish writer on *Dasenomy*, and formerly professor in our School of Forestry, to whom it is enough that I thus refer, while passing on to state succinctly the new form, the multiplication and general organisation of forestal schools which occurred in Germany, and in some other countries in Europe.

"The primary organisation of the schools founded in Ilsenberg, Wernigerode, Lauterberg, Hungen, Zillbach, Walterhausen, Rottenhaus, Castell, &c., in the period from 1766 to 1805, was that of several other private centres of instruction, which died out with their founders, or suffered the fate which befell these in the course of their existence. All these made themselves remarkable by the great impulse and development which they gave to the diffusion of forest science, and by their having roused up a numerous and distinguished body of men to assist, and direct at a later time the work of bringing into order the forests of the districts in which they were situated. There stands out prominently amongst all these the school founded by Cotta. He, being charged with the reduction to an orderly condition of the forest of Fishbach, spent some years in the execution of this work, and during these years giving theoretic and practical instruction to the young men who assisted him there: thus was instituted the new centre of forestal instruction of Zillbach. Such reputation was acquired by this establishment of modern times, that in 1795 there was granted to it a subvention from the State, thanks to which he was able considerably to augment the means available then for the prosecution of study. In 1810, Cotta was appointed Director of Forest Management in Saxony. He at once perceived and pointed out the lack which existed of a skilled staff of officials who should execute and assist in the execution of his projects, and with a view to meeting this desideratum the promoted school of Zillbach was transferred to Tharand in 1811, and ceded to the Government on the 12th of May, 1816. Converted into a Government academy and furnished with all necessary resources, the School of Tharand, devoted to the instruction of the forest engineers of the State, very soon flourished beneficently, attracting to study there the studious youth of many different countries; and serving as the sharp edge of a wedge for the general diffusion of those truths which, spreading themselves a little later in different countries, proved the occasion of there being opened other schools which take pride in calling themselves daughters of the Saxon Academy.

"In their turn, in Austria and Russia—nations which, if they did not take the first step, followed at once the advancing march of the States of Germany—there had been organised schools of forestry: those in Austria having the character of a private establishment in the beginning, and those of Russia being Government institutions from the first. Amongst these, the first established—that founded in 1770 by Ehrenwerk in Rotherhaus, in Bohemia—continued till 1791. This was succeeded by another, established in the beginning of the present century in Kruman; and coincident with its appearance we meet with the schools of Eisgrub in Moravia, Eisenstadt in Hungary, and Gratzen in Bohemia.

"Passing from private seminaries to public and Government institutions, there were founded the Schools of Datschets in Moravia, and that of Plass in Bohemia, opened in 1823 and 1830, in which there is some Government intervention, but it is very limited. When the Government was once convinced—as was the case likewise with the Government of Germany—of the urgent necessity there was for entrusting the administration of forests to a staff of officials endowed with special scientific knowledge, they arranged in 1805 the opening

of a course of practical instruction in sylviculture in Purkersdorf, near Vienna; and subsequently, in 1813, increasing the staff of professors, and with a well-considered plan of instruction this school was transferred to Mariabrunn, not far from the capital of the empire. In 1827 the plan of study was changed, and the subjects of study were divided into four *semestres*, or half-year sessions; ultimately, in 1852, this was reorganised by distributing over three years the study of the different prescribed subjects which comprised the course followed by forest engineers."—*Indian Agriculturist.*

PLANT CELLS.—From an early period in the history of Vegetable Anatomy—from the time that Grew and Malpighi demonstrated the varied internal cellular construction of plants—experiments to demonstrate the use of these varied structures have been made. And now, when this department of botany has taken a sudden bound onwards, and chemical re-agents have come to the help of the microscope, it may be hoped that substantial progress may be made in this direction. The structure of plants, like their outward conformation, is partly an hereditary endowment from generation to generation, partly the result of progressive adaptation to certain conditions. So long as the power of adaptation or accommodation to circumstances remains, so long is there room and opportunity for variation as occasion may demand. On the other hand, it is conceivable that plants which have for a long series of ages become adapted or accustomed to one uniform set of conditions remain unaffected, do not vary when those conditions are altered, or, being unable to accommodate themselves to new circumstances, die out. On some such principles, probably, depends the fact that the gardener can grow certain plants without difficulty, while others defy all his efforts. But to descend from the region of speculation to that of practice, we may point out that the internal conformation of plants sometimes offers as good hints to the cultivator as to the conditions under which certain plants may be expected to thrive as the more easily observed external appearances do.

By way of illustration we may mention the presence in the leaves of certain plants of what are termed palissade-cells. These are oblong cells, arranged vertically, that is, at right angles to the surface of the leaf. Their form and direction may be indicated thus ||||, the ordinary leaf-cells being more or less globular or branching, or, if elongated, then elongated horizontally in a direction parallel to the surfaces of the leaf. The term "palissade-cells," then, very well expresses the form and arrangement of a certain class of cells packed closely together, like the wooden rails of a park fencing. A very low power of the microscope is sufficient to allow these cells to be seen, and in some cases an ordinary pocket lens, if of tolerably high magnifying power, is sufficient to enable them to be seen. These

palissade-cells are usually filled with "leaf-green," or chlorophyll.

We cannot here pursue the subject from the point of view of the anatomist or physiologist, it must suffice to point out the practical deductions which are insisted on by Stahl, Vesque, and other students of this particular structure. When a gardener, says M. Vesque, in substance, receives a new plant of imperfect or unknown history, he does not pay much heed to systems of classification, as a botanist would do, for they afford him little help. He judges by the external appearances of the plant what is likely to be the appropriate treatment, and so, for instance, he submits to the same general conditions Stapelias and Aloes, Agaves and Mesembryanthemums, and so forth—plants, in fact, whose "habits" and requirements are the same, whose adaptive characters, that is, are identical, although their more purely hereditary peculiarities are widely different. In the case of succulent plants, such as those just mentioned, the matter is easily determined; but in those cases where the exterior appearance gives no indication of the habit and requirements of the plant, then a microscopic examination must be made, and this will enable the observer to say with something like certainty whether the plant naturally grows in the sun or the shade—whether its internal structure is such as to allow of free or of relatively little transpiration—whether it is likely to demand frequent and copious waterings, or whether it is capable of living long without any. We may give a few illustrations. If the palissade-cells are abundant and well marked, the probability is that the plant requires a proportionate amount of exposure to light; *if, on the other hand, the palissades* are scanty or not present, the inference is that the plant requires to be grown in the shade. Between these two extremes is a group of plants of variable and inconstant nature: such plants obviously are enabled by Nature to adapt themselves more or less successfully to different conditions.

In the case of moisture, the subject may be divided into the discussion of the arrangements for, in the first place, the supply of water; and, secondly, for its retention and storage. Indications as to the supply, great or little, may be gathered from the thickness of the cuticle, and the number and position of the pores or stomata.

As to the faculty of storage, that may be judged of from the nature of the epiderm or skin beneath the cuticle, the abundance of cellular tissue—that is, the succulence of the leaf, and other characters. The first set of characters supply hints as to the absolute quantity of water required; for instance, the thinness of cuticle and abundance of stomata would naturally suggest frequent and copious waterings; the second set of characters suggests the abundance and frequency of water, whether little and often, or a large quantity less often. Plants

whose thick rinds indicate a relatively little amount of transpiration naturally require a *hotter temperature and a fuller exposure* to light than others.

A plant with small pores or stomata transpires less than one with large or with numerous pores. Hairs on the surface check transpiration, spongy construction of the leaf is also an indication of relatively little transpiration. Obviously, the more fleshy the plant the less need there is for watering frequently.

Hard woody cells, such as those which constitute the grit of a Pear, and which serve as a sort of skeleton to support the tissues, are taken by M. Vesque to indicate that the plant is exposed to bright sunlight and occasional drought, as Proteas, &c., or to occasional excessive losses of water, and indicate the necessity for copious watering at intervals, as in the case of succulent plants.

Pursuing his subject M. Vesque goes on to show how the epidermal cells, or those sub-adjacent to them, in some cases act as reservoirs for water; and how in the tissues of some leaves may be found other structures having a similar office, so that the thick rind, the deficiency of stomata, the dense hairs with which plants growing in dry places are provided, indicate the quantity of water which traverses the plant, while the reservoirs for water furnish indications as to the frequency of watering and the length of interval between the operations.

The intelligent observer, adds M. Vesque, will know how to avail himself of the indications presented to him, which will be varied and combined in a thousand different ways, but from which he will be enabled with accuracy and judgment to regulate the delicate operation of watering.

We have no doubt whatever that M. Vesque is on the right track, but we fear it will be long before our young gardeners will avail themselves of the help of the microscope rather than of the rough-and-ready measures that they are accustomed to practise. In any case it will be admitted that there are few operations in practical gardening which are carried out with less intelligent judgment than is watering, and any means which may serve to obviate this will be a boon to head gardeners.

Lastly, we may mention that we have put M. Vesque's notions to a partial test *with reference to the leaves of Orchids*, which present remarkably great variations of structure, and in some cases of great interest. We have examined one or two dozen species, with the general result of confirming M. Vesque's notions, or, at least, of satisfying ourselves that "there is something in them." On another occasion we may speak more fully on this point.—*Gardener's Chronicle.*

ABIES WEBBIANA.—Few, if any, of our conifers are more handsome than this denizen of the Himalayas. The bold overlapping, densely crowded foliage of a silvery white on the under-surface,

and the noble dark purple cones, indeed, render it a most striking species. The botanical history is well known, and the tree is adequately described in the text books. It is only necessary for us, therefore, to allude to one or two points of structure, such as the leaves, which diverge on each side from the branch, leaving a wide furrow or parting between them on the upper surface. The buds are sub-globose, pale cinnamon-brown, and covered with resin. As to the leaf structure some discrepancy exists between the accounts given by Bertrand and McNab; the former says the structure is the same as that of *A. Pindrow*, which he further states has a disconnected scanty layer of strengthening fibres (hypoderm) beneath the epidermis; MacNab, however, describes the hypoderm as continuous, and so we also find it. The outline of the leaf-section is different in the two forms; in *Webbiana*, the margins are pointed and recurved, while in *Pindrow*, they are blunt, rounded, and but little recurved. These little details are important, because while in the opinion of some, *Webbiana* and *Pindrow* are distinct species, in that of others, they are only two forms of one and the same. Certainly in English gardens, the two look different, and the question whether they belong to one species or not, is one which will be answered by each observer according to his proclivities. Brandis, in his "Forest Flora of North-Western and Central India," leans to the view that the two forms are varieties of one species ranging from Afghanistan on the west, to Bhutan and Sikkim on the east.

The form called *Webbiana* occurs on rocky ridges at higher elevations, and is a smaller tree with shorter, less bifarious leaves, and usually thicker and shorter cones. Var. *Pindrow* occurs on better soil in sheltered places, and is a large tree with longer and narrower leaves and generally cylindric cones. *A. Webbiana* occurs in various parts of the Himalaya, at elevations of from 8,000 feet to 13,000 feet, forming extensive forests mixed with maples and birches, and often associated with *Abies Smithiana* and *Pinus excelsa*. In Sikkim it occurs with yews, oaks, rhododendrons, and bamboos. It thrives best in cold, damp glens. From the dark colour of the adult foliage it gives the name of "black forests" to several mountain forests of the north-west Himalaya. In this country it is "spring tender," owing to the early period at which it starts into growth. In its native country it attains a height of 120 feet to 150 feet, and a girth of 9 feet to 15 feet. The tree forms a tall cylindrical crown, like that of a Lombardy poplar. The bark of the young trees is silvery-grey, becoming darker as it advances in age. The wood is whitish, inodorous, soft, useful for indoor constructions, but not suitable for use where exposed to the weather.

On the Jhelum, according to Brandis, the leaves are used as fodder, and are stored for winter use. Wallich, who orginally described the tree, speaks of a violet dye being yielded by

the cones in Nepal. Captain Webb, after whom the species was named by Wallich, first met with the plant in Nepal, and in Lambert's "Genus Pinus" occurs the following passage from his pen, as to its beauty:—"The silvery hue of its bark, the beautiful contrast of the leaves with the rich purple of the cone glittering with globules of transparent resin, produce, in combination, one of the most striking objects that can well be imagined."

Major Madden, in his valuable paper on Himalayan Conifers, reprinted in Vol. V. of the "Journal of the Horticultural Society, London, 1850," says that *Pindrow* grows at lower elevations than *Webbiana;* and also that in habitat, and several marked peculiarities and constant differences between the two forms, which the natives attribute to climatal causes: "This persuasion of the force of circumstances in the transmutation of species is by no means uncommon in the Himalaya." Hooker mentions *Webbiana* as the most abundant pine in Sikkim. Veitch "Manual of Coniferæ" considers *A. Pindrow* to be distinct from *Webbiana*, and more tender in cultivation. As to *Webbiana*, he recommends that young plants should be protected by a slight covering during frosty weather, so small an amount of trouble being well worth taking to preserve so beautiful a tree. As the tree gets older it ceases to need even this precaution.—*Gardeners' Chronicle.*

IT was only the other day we had occasion to remark that the teak wood imported into Madras from British Burmah was not only deficient in quantity, as compared with that supplied to Calcutta and Bombay, but was also inferior in quality, and that the supply from the local Forest Department was insufficient to meet the requirements of the service. We now see that the matter has attracted attention in that Presidency. On the 20th of October last, Captain W. L. C. Baddeley, R.E., General Superintendent, Public Works Stores, wrote to the Superintending Engineer, V. Circle, as follows:—"With reference to the G. O. of 15th March, 1884, on the subject of laying in a stock of teak for the use of the Public Works Department, I have the honor to forward copy of a letter received from the officiating Conservator of Forests, Pegu Circle. The Madras Forest Department are unable to supply the teak required, *vide* copy of letter from the Collector of Coimbatore. The price of teak is very high in the Madras market, and I think it is most desirable that a large stock should be laid in to ensure the supply to the Public Works Department of good sound timber at a moderate price. The attempt to obtain *jarah* wood from

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Note.—We hold the opinion that the *A. Webbiana* is merely a dwarfed variety due to the inclement climate in which it grows. It is found near the limit of vegetation, associated with birch and white rhododendron.—[ED.]

Australia has failed; and even if it had been successful, I consider that the difficulty of working it would have been a great bar to its use; for similar reasons, I do not think that *karrai* timber could be economically used for the ordinary work of the Public Works Department, even if it could be delivered in Madras in large sizes at Rs. 100 per ton. I am making arrangements for a small supply of *sál* from Ganjam, but the cost of transit will, I fear, make the price prohibitory, and I am also doubtful about the size. As regards quality, I am convinced that, for the ordinary work of the Public Works Department, no wood is equal to teak; and I therefore think that it will be found economical and satisfactory to accept the offer of the Conservator of Forests, Pegu. The selection and measurement of the wood might be safely left to the Forest Department. Their offer refers to good sound teak from 25 to 30 feet long and 6 feet girth, which is exactly the class of logs required; but if it is considered necessary, the Executive Engineer, Rangoon, might be asked to pass the timber before shipment." *Enclosure.*—From H. C. Hill, Esq., officiating Conservator of Forests, Pegu Circle, to the General Superintendent, Public Works Stores, Madras, dated Rangoon, 6th October:—"In reply to your No. 760, dated 13th September, 1884, I have the honor of informing you that I can supply you in November with 400 or 500 tons of good sound teak logs, 6 feet in girth and from 25 to 30 feet long, at Rs. 95 per ton of 50 cubic feet, delivered ex steamer at Madras. 2. I should require you to arrange for the selection and measurement of the logs at the depôt in Rangoon." —*Indian Agriculturist.*

M. HANSEN-BLANGSTED contributes to *L'Exploration* an interesting article on the struggle between trees in the Danish forests. The chief combatants are the beech and the birch, the former being everywhere successful in its invasions. The paper refers especially to the district of Silkeborg in the heart of Jutland. Forests composed wholly of birch are now only found in sterile sandy tracts; everywhere else the trees are mixed, and wherever the soil is favourable the beech rapidly drives out the birch. The latter loses its branches at the touch of the beech, and devotes all its strength to its upper part, where it towers above the beech. It may live long in this way, but it succumbs ultimately in the fight—of old age if of nothing else, for the life of the birch in Denmark is shorter than that of the beech. The writer believes that light is the cause of the superiority of the latter, for it has a greater development of its branches than the birch, which is more open, and thus allows the rays of the sun to pass through to the soil below, while the tufted, bushy top of the beech retains them, and thus preserves a deep shade at its base. Hardly any young plants can grow under the beech except its own shoots; and while the beech can

flourish under the shade of the birch, the latter dies immediately under the beech. The birch has only been saved from total extermination by the facts that it had possession of the Danish forests long before the beech ever reached that country, and that certain districts are unfavourable to the growth of the latter. But wherever the soil has been enriched by the decomposition of the leaves of the birch the battle begins. The birch still flourishes on the borders of lakes and other marshy places, where its enemy cannot exist. In the same way in the forests of Zeeland the fir forests are disappearing before the beech. Left to themselves the firs are soon replaced by the beech. The struggle between the latter and the oak is longer and more stubborn, for the branches and foliage of the oak are thicker, and offer much resistance to the passage of light. The oak also has great longevity, but sooner or later it, too, succumbs, because it cannot develop in the shadow of the beech. The earliest forests of Denmark were mainly composed of aspens, with which the birch was apparently associated ; gradually the soil was raised and the climate grew milder ; then the fir grew and formed large forests. This tree ruled for centuries, and then ceded the first place to the holm oak, which is now giving way to the beech. Aspen, birch, fir, oak, and beech appear to be the steps in the struggle for the survival of the fittest among the forest trees of Denmark.—*Nature*.

THE following extracts are from the resolution of the Chief Commissioner of Burmah on the Land Revenue administration for 1883-4 :—

Fodder Reserves and Arboriculture.—There is one fodder reserve near Rangoon, which was taken up and is kept for the use of the Commissariat Department. For the pasturage of village cattle, grazing-grounds are being set apart in all districts to which the survey and settlement has extended. The business of demarcating these grazing-grounds is not completed in any district, and the selection of grazing-grounds is still going on. Next year complete figures will be furnished of the grazing-grounds selected and of those demarcated up to date. In the unsettled districts, the grazing-ground question has been less systematically pursued ; but there the available grazing in unreserved forests and savannahs is extensive, and therefore the matter is less pressing. In the small forest reserves, which abut on, or are in the middle of rice plains, grazing is allowed to neighbouring villages on easy terms.

Surveys.—Three Cadastral Survey parties and one Topographical Survey party were at work in the province during the year. The Topographical party were engaged in mapping the forest reserves, in order to facilitate the preparation of proper Working Plans of the State Reserved forests. The work of this party, which cost Rs. 393 per square mile for a total outturn of 263 square miles, has been noticed in the annual forest report, and requires no further mention here.

In the settled districts, large areas of hilly country, of woodland, of swamp, of savannah, and of tidal forest, have been or will be omitted from the cadastral survey. They will hereafter, have to be mapped by some less costly method of survey in order to complete the geographical material of the province.

THE VALUE OF AMERICAN FORESTS.—The magnitude of the forestry products of the United States is shown by recent statistics. These demonstrate that notwithstanding the enormous value of the corn crop, it is slightly exceeded by the annual value of the forest products. The following remarkable figures show the value of the principal products of the country in their regular order for the year 1883: Forestry, $700,000,000; corn, $679,714,499; wheat, $474,291,850; hay, $371,811,084; cotton, $280,266,242; oats, $150,243,565; gold and silver, $74,400,000; coal, anthracite and bituminous, $64,500,000; iron ore, $20,470,000; and total other mineral products, $218,385,452. By far the largest portion of the forestry products is used as lumber. As lumber it is used for building material, fencing, and innumerable manufactures; and it also enters into the industries of the people in many forms. It appeared by the last census that the value of the wood used annually in cooperage was $33,714,770. Several million dollars' worth are annually consumed in the manufacture of baskets. The chief of the forestry division of the Agricultural Bureau states that 2,999,542 cords of bark were used in tanning in 1880, at an average cost of $6 per cord, which would bring the aggregate value of bark up to $17,456,252. This does not include the value of trees cut for bark and left to decay. The lucifer matches consumed in the United States require wood to the value annually of $3,298,562.—*Times.*

WE understand that Mr. Lowrie has found indigenous teak growing in the Marwar Aravalli Hills, at 73° 18′ West and 24° 42′ North.

THE

INDIAN FORESTER.

Vol. XI.] February, 1885. [No. 2.

We were very glad to see that Messrs. Puton and Boppe had been included in the list of recipients of New Year's Day honors by Her Majesty, the Queen-Empress, and had each been made Companions of the Indian Empire. Since 1867, there has been a regular succession of British subjects at the Nancy Forest School in training for service in the Indian Forest Department, and as this training is to cease shortly, and to be provided for at the Coopers' Hill College, the present recognition of the services to India of the Director and Deputy Director of the French National Forest School is most appropriate.

SOUTH AFRICAN INDUSTRIAL EXHIBITION.

(*Continued from page 10.*)

SECTION I.

Indigenous and Naturalised Trees.

First Group; North, Central, and Western Regions.

1. Widdringtonia juniperoides (Endl.)—Cedar Tree, Cedar Boom.

Exhibits: 3 planks (3 feet long), 2 blocks.

This magnificent wood, equal in its qualities to the Cedar of the Bible, may be seen in the Church at Clanwilliam, where it has been used for all the internal wood-work. It was formerly very abundant, and is capable of attaining immense dimensions in diameter, according to what Dr. Pappe relates in his "Sylva Capensis," para. 36:—

"Sir James Alexander, in his exploring expedition in the interior of Africa (Vol. I., pp. 230-299), mentioning the Cedar tree, says that one of them was cut down in 1836 which was 36 feet in girth, and out of whose giant arms 1,000 feet of planking were sawn. He bitterly complains that this noble tree is fast disappearing in the Cedar Mountains. Mr. W. von Meyer (Reisen in Sud Africa während der

Jahre 1840-41; Hamburg, 1843 (800) page 181), another South African traveller, says that in former days the whole of the mountain chain to which the Cedar Mountain belongs was studded with those trees, but that of late the axe and conflagrations have done their utmost to destroy the valuable forests."

The few Cedar trees which still remain have not had time to attain more than 1 or 2 feet in diameter, nor are they more than from 15 to 20 feet in height. They are scattered here and there among the abrupt crags in the highest parts of the mountains, covered with snow in winter. The wood-cutters seek out even these with the utmost eagerness, and consider the wood well worth the trouble of carrying on their shoulders to the valley below, which is the only way of getting it down from the places in which it has taken refuge. The restoration of the forest in these mountains should be one of the first cares of the Forest Department in the Cape Colony.

2. *Euclea pseudebenus* (E.N.)—Cape Ebony.

Exhibit: 1 small specimen.

This wood, which is very valuable, is found growing on the borders of the Orange River. Whether it is associated with another tree of the same parts, more valuable still (*Acacia Giraffæ*—Camel Thorn) (see collection of seeds), or whether it alternates with it, we have not been able as yet, through want of data, to ascertain. Nor have we been able to give any information respecting the quantity of each sort available, or the facility of reproduction. It is sufficient to say that the inhabitants of the district destroy both these trees recklessly for fuel, and if the care of these woods is delayed much longer, they will disappear in the same manner as the Cedar of Clanwilliam.

3. *Capparis albitrunca* (Burch.)—Witgat Boom.

Exhibit: 1 small block.

The trunk of this tree appears from a distance as though white-washed. It grows in the driest situations; it is very subject to the defect "Lunure;" under certain conditions its growth seems to overlap the bark. Wood white, tough; used for yokes.

Contributed by Mr. Dunn, Colonial Geologist.

4. *Leucodendron argenteum* (R.B., 2)—Silver Tree.

Exhibits: 3 planks, 2 blocks, 2 logs, leaves, cones, and seed.

Grows quickly, reproduces itself easily; employed formerly for furniture and building purposes, now not much used except for firewood. The wing of the seed is composed of four feathers, in the form of a cross, threaded on a slender axis on which it slides up and down. It presents a very curious appearance to the observer. Is remarkable for its silvery foliage; found as a forest tree on Table Mountain. Attains a height of 50 feet and 18 inches diameter (see "Tree-planting," by J. S. Lister).

4a. *Leucospermum conocarpon* (R.Br.)—Kreupelboom.

Exhibits : Bark.

5. *Rhus viminalis* (Vahl)—Karee-wood.

Exhibits : 3 planks (3 feet long), 1 block, seed.

Remarkable for the flexibility of its wood ; grows along water-courses, usually dry, in the Karoo.

According to Dr. Pappe, it has the advantage of not being infected by noxious insects. Grows from truncheons.

6. *Acacia horrida* (Willd)—Thorn Tree.

Exhibits : 3 planks (3 feet long), 1 block, seeds.

A very thorny tree ; bark, dark grey ; contains a large portion of the tanning principle. Wood used for wheels, furniture, yokes, poles, and rural implements.

The thorn tree may be said to be the most common tree met with in the lonely wastes of South Africa. There it inhabits the borders of every stream, and points out at a distance to the exhausted traveller the cherished spot where he may quench his burning thirst, and screen himself from the scorching rays of the African sun (Dr. Pappe).

7. *Acacia (decurrens?)*—Port Jackson Wattle.

Exhibits : 1 block, bark and seed.

(See "Tree-planting," J. S. Lister).

8. *Acacia glaucophylla.*

Exhibit : 1 block.

(See "Tree-planting," J. S. Lister).

9. *Laurus Camphora*—Camphor Tree.

Exhibit : 1 plank (contributed by Messrs. Isaacs and Co.), 1 piece of a sleeper.

The latter having been 20 years in the ground. Contributed by the Railway Department.

(See "Tree-planting.")

10. *Eucalyptus globulus*—Blue Gum.

Exhibits : 3 blocks.

One grown in marshy ground, seven years old ; plantation at Worcester 70 acres ; trees 60 feet high. A specimen in the Botanic Gardens, Cape Town, 18 feet in circumference. Introduced in 1844.

(See "Tree-planting.")

11. *Pyrus communis* (Lin.)—Pear Tree.

Exhibits : 2 blocks.

Attains great dimensions in the Colony. Is capable of taking a good black colour, and if so prepared is difficult to distinguish from ebony.

12. Populus alba (Lin. ?)—Poplar.

Exhibits: 2 planks, 2 round blocks.

This tree does not attain great dimensions, but possesses all the qualities which characterise its wood in a warm climate.

13. Quercus pedunculata (Ehrh:)—Oak.

Exhibits: 2 blocks.

Wood presents all the characteristics which distinguish it in Southern Europe.

14. Pinus pinea (Lin.)—Stone Pine.

Exhibits: 2 planks, 2 blocks.

On the borders of the Mediterranean it furnishes timber of the first quality, and is used in shipbuilding for bulwarks and even masts; very useful in all carpentry. Is of equal, if not greater value in the Colony.

Specimens No. 11, 12, 13, and 14, were contributed by M. Le Vicomte de Montmort.

All the specimens of this group were polished by Messrs. Stigant & Co.

Second Group: South-West Zone.

15. Oreodaphne bullata (Nees ab. E.)—Stink-wood.

Exhibits: 1 square block, 2 round blocks, 1 plank 6 feet long, 2 planks of 3 feet, 3 veneers, and bark.

So called from the disagreeable odour it emits when worked up. A tree with a generally mis-shapen crown, sometimes attaining a height of 50 to 60 feet, and a diameter of 4 to 5 feet. Bark smooth, of a silver grey when young, scaly and almost black at maturity. This wood is very highly prized, being little inferior, if not equal, to Teak in strength and durability. There are three varieties of Stink-wood; the white, the mottled, and one which is almost black. These differences are probably due to the tree having been grown under different conditions rather than to any botanically specific difference.

Stink-wood is used for nearly every kind of work in buildings, in wagon and cabinet-making, &c. The Railway Department have used Stink-wood in places such as sharp curves, where greater strength and resistance were required. Stink-wood takes an excellent polish, and when thus treated is not unlike Walnut. Unfortunately, this valuable tree has become very scarce in the forests where it formerly abounded. It only exists now, in any quantity, in the unworked forests of the Zitzikama; and during his last journey the Count de Vasselot found young plants in the forests of Isidenga, near King William's Town. The Government, however, are now taking this matter up, and by enforcing a stringent code of regulations, and working the forests in a systematic manner, they are preventing the ruthless

destruction of any particular species of timber. Though growing frequently to a height of 60 or 75 feet, Stink-wood is very rarely found growing quite upright: the reason of this is believed to be that most of the trees are produced from coppice shoots.

The Stink-wood seedling is endowed with a hardy constitution. As soon as it reaches a ligneous state it requires plenty of air, and to be allowed to participate freely in the various atmospheric influences, such as light, dew, &c. Stink-wood cannot stand dense shade for any length of time. Its young shoots are soft and succulent, and are easily injured if bruised or rubbed against. Stink-wood prefers damp, cool localities, and up to a certain point is not injured by excessive wet. It reproduces itself by a process of natural coppice which is extremely curious. The trunk of an old tree will die from the top downwards, and then, from the base, will be produced a sheaf of young shoots growing up around the trunk of the original tree, now become an old, dead log. These dead logs remain standing a long time before they decay, and are frequently in great part utilised, and sawn up into good, sound, seasoned timber. Again, as the old trunk decays, the young shoots may be observed, especially at Zitzikama, sending out young roots, which run down outside the old trunk and eventually reach the soil where they take root. Thus, gradually, these young shoots become independent of the old stump and stand alone, though somewhat weakly established, on their own roots.

Young trees produced in this curious way are very liable to become windfalls. Sound Stink-wood occurs up to 3 feet in diameter, but it is reported that large, sound logs are getting scarce every day. The breadth of a Stink-wood crown is difficult to estimate, because the different shoots spreading upwards from the old stump might almost be considered as different trees, and leaning outwards they extend over a large amount of ground. But as the leaves are not very abundant, except at the summit, the actual amount of "covert" thrown is not great.

Stink-wood, except when young, has neither the appearance of a well-grown nor of a healthy tree. At an early stage of its growth the crown of the tree becomes disfigured and deformed by the presence of large, dead branches; and eventually, as has been explained above, the whole tree dies gradually down to the ground. Usually the dead branches in the crown can be observed being replaced; often they must be caused by large gormandizers developing along the trunk.

The seeds of Stink-wood are greatly destroyed by grubs; they are like small acorns in appearance. It is believed that Stink-wood is propagated to some extent by the berries being swallowed and the seeds passed by birds.

In a log cut at a height of 3 feet 5 inches from the ground,

120 rings were counted, but it seems doubtful if the tree does not form more than one ring per year. A full-grown Stink-wood tree of 3 feet in diameter, will generally yield, on an average, about 17 cubic feet of timber for planks and beams, and about 50 cubic feet which may be used as small wood for furniture, &c. The sap-wood of Stink-wood averages about 2 inches, the bark is about 1 inch thick, and there is often a central core 1¾ inches thick of partly decomposed wood. The weight of a cubic foot averages 54·168 lbs. Stink-wood grows from the sea-level (and within a mile of the sea on a southern aspect) up to an elevation of about 3,000 feet.

In the forests of the Knysna Conservation there have been marked for cutting in the open sections during 1884, 2,054 Stink-wood trees, measuring 46,932 cubic feet of squared timber, and valued at license tariff at £2,297 12*s*. The mean consumption of preceding years was only 33,975 cubic feet per annum, according to the returns of licenses issued.

(*To be continued*).

CYPRUS.

In 1879 when Lord Wolseley was High Commissioner the first "Woods and Forests' Ordinance" was passed in Cyprus. By this Act all the forests were brought under the protection and control of Government. According to Turkish Law, which is still the law of this Island, all land is the property of the State, and freehold property as such does not exist. The revenue is paid in kind, the latter belonging to the Government: but if lands remain uncultivated for 3 years the right of ownership lapses; also under Turkish rule any one could clear and cultivate waste or forest land, and after 10 years' continual occupation the holder of such land could claim a title-deed subject *to the condition of cultivation at least once in three years.* The Ordinance of 1879 stopped in a great measure the reckless clearing of forest land which were chiefly taken up for vine fields, but it was found that the forests could not be adequately protected till their boundaries were defined and fixed; this necessitated the passing of a Forest Delimitation Ordinance in 1881, and in the end of that year a Delimitation Commission, consisting of an Assistant Commissioner as President and two natives as Members, one a Turk, the other a Greek, commenced work. Shortly after the post of Assistant Commissioner was abolished, and the Principal Forest Officer was appointed as President of the Commission, and has had to conduct this in addition to his other duties.

As the forests are mainly situated on the mountains at an altitude of from 3,000 to 4,000 feet, the work of delimitation can be carried on only in the spring and summer months. Up

to date about 230 square miles of forest boundaries have been defined, thus leaving about 120 square miles still to complete this work in the Island. There being no grass, and as the undergrowth is very sparse and scattered, the boundary marks, which at present consist of cairns of loose stones, can be seen at considerable distances. An English Surveyor has been attached to the Commission, and plans of the delimited areas have been prepared showing position of boundary marks and other details.

The following is a list of the trees and shrubs and plants met with in the Island. The letters R, VR, C, VC, denoting rare, very rare, common, and very common.

	Cupressus fastigiata, ...	R.
1.	Pinus halepensis (Aleppo Pine),	VC.
2.	,, Laricio, ...	C. on Troodos.
3.	Cedrus Libani, ...	R.
4.	Quercus alnifolia, ...	VC.
5.	Arbustus Andrachni, ...	VC.
6.	Juniperus Phœniciæ, ...	VC. in calcareous soils.
7.	,, fœtidissima, ...	R.
8.	,, rufescens, ...	VR.
9.	Ceratonia siliqua, ...	VC. in the plains.
10.	Pinus pinea,...	VR.
11.	Alnus orientalis, ...	R.
12.	Quercus infectoria, ...	VR.
13.	,, Pfæffingeri, ...	VR.
14.	,, inermis, ...	R.
15.	,, pseudo-coccifera, ...	R.
16.	Celtis australis, ...	VR.
17.	Platanus orientalis, ...	C. in ravines.
18.	Populus nigra, ...	C. ,,
19.	Olea europœa, ...	C. on low hills.
20.	Acer creticum, ...	VR.
21.	,, obtusifolium, ...	VR.
22.	Pistacea Terebinthus, ...	C. on low hills.
23.	,, lentiscus, ...	C. ,,
24.	Berberis Œlnensis, ...	C. in the plains.
25.	Cistus, ...	VC.
26.	Rhus Coriaria, ...	C.
27.	Myrtus communis, ...	R.
28.	Ulex europœus, ...	C.

One of the chief articles of export is the carob-bean (*Ceratonia siliqua*) ;—only the bean of the grafted tree is of any value.* The carob does not thrive in the higher altitudes ; it is found in great abundance near the coast on the north and south of the Island. Its wood is excellent for wheelwrights, &c., and it yields charcoal of the first quality. For this latter purpose only are the ungrafted trees, or rather bushes, used.

* Enthusiasts in India should note this fact.

Next to the two pines the *Quercus alnifolia* is the most abundant wood. It never attains a large growth, 2 feet in diameter at most, and grows slowly. It yields excellent material for ploughs and wheels; but its great use on the mountains consists in binding the soil.

A great obstacle against introducing conservancy measures are the "Monastez." There are some dozen of these scattered among the mountains, they are generally situated in some most retired nook in a gorge or dell, and they all possess large flocks of goats and claim extensive grazing rights in the forests. The largest Monastez, Kikko, is situated in the heart of the forests, and owns some 20,000 goats; these, during the summer months, pasture wild without being herded, and I have come across a couple retainers of the Monastez shooting goats for "meat."

December, 1884. E. DOBBS.

FOREST NEWS FROM THE CAPE.

SIR,—With reference to the "Indian Forester's" extract on "Timber for Tea Boxes in China" and Sir Joseph Hooker's information that *Pinus sinensis* is the best wood and the wood most largely used by the Celestials for tea boxes, it may interest your readers to learn that *Pinus sinensis* is growing well in the forest nurseries recently formed in the east of Cape Colony.

I have just received from the Mysore Forest Department (through my brother at Bangalore) a supply of Casuarina seed for trial on the dunes of the coast near East London. And I take this opportunity of mentioning, for the information of those who kindly proposed to send me seed for trial, on a former occasion, that an ordinary stout official envelope will contain a small handful of light seed, and preserve its figure sufficiently to reach King William's Town unchallenged by an objective Post Office. Larger packets of seed may be sent by Indian parcel post to Messrs. G. Wheatley of Waterloo Place, London, who will forward to me; all charges being collected by their agents in King William's Town. A chest of Nilgiri tea reached me a few days ago forwarded in this way by Messrs. G. Wheatley, and there would not be the slightest difficulty in forwarding packages of seed by this route.

East London is a busy port at which the mail steamer from England calls once a week: and East London is three hours by rail from King William's Town my head quarters.

I have a nursery in a semi-tropical forest near the coast, where it would be worth while, if only for the interest attaching to the experiment, to try species from the plains of India.

But in the Eastern Mountains, where there are now seven

forest nurseries, every Himalayan species ought to succeed, at elevations from 2,000 to 5,000 feet in the Amatola mountains. It is impossible to predict what development may not be taken by some of those strong Northern species in this soft Southern climate, and among the species of such a comparatively restricted forest flora as that of Cape Colony. Consider the Australian trees on the wind-swept Nilgiris, the Casuarina on that burning Madras coast, the beautiful natural forests (on a small scale) of the introduced Pines and Oak in the bare Cape Peninsula. *Of Himalayan trees, the Box, Deodar, Pines and Oaks,* Walnut, and also Bamboos, present a tempting list.

Ye Foresters of the grandest mountains in the world, think of these other snowy mountains across the Indian Ocean! Some day there may be "Himalayan trees in the Amatolas" to write about—or possibly, *vice versâ*, though this is less likely. Nevertheless many Indian Foresters will doubtless be curious to see and grow some of those curious and valuable Cape trees which have recently come before the world at the Forestry Exhibition in Edinburgh. Cape Box pronounced to be worth about a penny a square inch for engraving, those gigantic* Yellowwood trees, that imperishable Sneezewood, the useful Stinkwood easy to work and with many of the qualities of Teak, tough White Ironwood, Cedar-like Assegai, handsome furniture woods, &c.

I will despatch shortly a box of selected seeds to the Director of the Forest School at Dehra Dún, who will doubtless kindly undertake to distribute them to Himalayan nurseries. A little Sneezewood seed was sent last year to Madras for trial on the Nilgiris. I propose sending a further supply of Sneezewood and other Cape trees this year to the Nilgiris. But, climatically, it is between the Himalayas and the Amatolas that an interchange of forest seeds is most likely to be productive of results.

D. E. HUTCHINS,
Conservator of Forests,
26th November, 1884. *King William's Town, Cape Colony.*

FOREST CLAIMED BY A TEMPLE IN MADRAS.

THE following curious complaint appeared in an address presented to the Governor of Madras by the inhabitants and Municipal Commissioners of Cuddalore. I send it, because I think you would be glad to put it in the "Indian Forester" as

* Dr. Brandis' forest flora mentions a Podocarpus native of Nepal and Burmah, in fact an important tree in Burmah. This genus so largely represented in the evergreen forests of the Cape and New Zealand is often and erroneously described as being confined to the Southern Hemisphere.

a note by the way, on account of its being so curious and one that has never been raised before.

"Our next grievance refers to the Proceedings of the Board of Revenue declaring the Jiruvannamalai Hill to be the property of Government, and authorizing the formation of a Government Forest Reserve on the greater portion thereof. Unlike any other sacred hill in the whole of India, the hill has by tradition been regarded as representing the deity of Siva himself, or an incarnation of his. This hill is of the form of a "Lingam," having eight holy bulls surrounding it and facing its top. These bulls were erected by our ancient Hindu Rajas in this position in order to show that the hill is their common Lingam. The pilgrims who flock to the place from all parts of India go round the hill and worship it as if it were a Lingam placed inside a pagoda. The hill was treated with great veneration not only by the former rulers of the country, both Hindu and Mohammadan, but also by the British Government itself, till the Board of Revenue passed the orders they have done. The form of the hill itself answers the description given in the Stala Puranas, and it is one of the five great Lingams representing the five elements, the hill in question representing fire. If your Excellency will be so kind as to go fully into the merits of the case, we feel sure that the conviction that the hill belongs to the Pagoda and forms the chief portion of it, and is not the property of Government, will force itself on your Excellency's mind."

C. INGRAM.

II. REVIEWS.

THARANDER FORSTLICHES JAHRBUCH.

Third Quarterly Number for 1884.

THIS number opens with an account, by Professor Kunze, of two experiments commenced in the Erzgebirg mountains in Saxony in 1862, with the view of ascertaining the effect of different degrees of thinning on the growth of spruce fir.

In the first case three plots, each containing 0·6837 acre, were selected, situated on nearly level ground at an elevation of 2,480 feet above sea level. The three plots were adjacent to one another, and together formed a rectangle, with its longest sides running north and south, plot *a* being on the north, *b* in the middle, and *c* on the southern extremity. The soil is described as a moist, tolerably deep, sandy loam, derived from the disintegration of gneiss. The trees were the result of a cluster plantation* found in 1840 at distances of 3′ 8″ × 3′ 8″, and in 1862, when the first observations were made, were consequently 22 years old. The overhead cover was then quite complete, and the growth throughout had been very good.

In 1862 the stock per acre on the three plots was as follows :—

Plot.	CONTENTS IN SOLID CUBIC FEET.		
	Timber.	Brushwood.	Total.
a, ...	1,707	1,115	2,822
b, ...	1,554	1,070	2,624
c, ...	1,631	1,092	2,723

In plots *a* and *b* these figures were obtained by actual measurements. In plot *c*, which was not thinned at all, the contents were estimated.

The results of the experiment are detailed below.

* "Büschelpflanzung," *i.e.*, 3 year old seedlings, are taken direct from the lines in which they were sown in the nursery, and set out in bunches or clusters of from three to five, or sometimes even more.

1st Experiment.

A. Heavily thinned plot.

Year.	Particulars.	Number of trees per acre.	Aggregate sectional area of trees at breast height per acre, square feet.	Average diameter of trees, in inches.	Average height of trees, in feet.	Contents per acre in solid cubic feet. Timber.	Brush-wood.	Total.	Rate per cent. of increment. During each period.	To end of each period.
1862	Thinnings, ...	...	...	...	...	279	188	467	...	...
1862	Timber left standing, ...	1624	91·3	3·2	24	1428	927	2355		
1863–67	Windfall, &c., ...	...	...	...	...	36	15	51		
1867	Thinnings, ...	...	...	...	...	41	15	56		
1867	Total standing timber plus intermediate yield since 1863, ...	...	...	...	...	2435	1074	3509	8·31	8·31
1867	Timber left standing, ...	1472	139·6	4·1	33	2358	1044	3402		
1868–72	Windfall, &c., ...	...	...	...	...	70	16	86		
1872	Thinnings, ...	...	...	...	...	23	6	29		
1872	Total standing timber plus intermediate yield since 1868, ...	...	...	...	...	3279	1442	4721	6·78	7·45
1872	Timber left standing, ...	1298	157·5	4·7	39	3186	1420	4606		
1873–77	Windfall, &c., ...	...	...	...	...	24	8	32		
1877	Thinnings, ...	...	...	...	...	161	141	302		
1877	Total standing timber plus intermediate yield since 1873, ...	...	...	...	...	3530	1390	4920	1·33	5·35
1877	Timber left standing, ...	1066	161·0	5·2	40	3355	1231	4586		
1878–82	Windfall, &c., ...	...	...	...	...	24	14	38		
1882	Thinnings, ...	...	...	...	...	183	42	225		
1882	Total standing timber plus intermediate yield since 1878, ...	...	...	...	...	4565	1359	5924	5·26	5·19
1882	Timber left standing, ...	924	176·0	5·9	47	4358	1303	5661	...	...

1st Experiment.

B. Moderately thinned plot.

Year.	Particulars.	Number of trees per acre.	Aggregate sectional area of trees at breast height per acre, square feet.	Average diameter of trees, in inches.	Average height of trees, in feet.	Contents per acre in solid cubic feet. Timber.	Brush-wood.	Total.	Rate per cent. of increment. During each period.	To end of each period.
1862	Thinnings, ...	...	...	...	...	76	77	153	...	...
1862	Timber left standing, ...	2177	98·9	2·9	23	1478	992	2470		
1863–67	Windfall, &c., ...	...	...	...	...	22	10	32		
1867	Thinnings, ...	...	...	...	...	61	30	91		
1867	Total standing timber plus intermediate yield since 1863, ...	...	...	...	...	2276	955	2231	5·52	5·52
1867	Timber left standing, ...	1913	138·3	3·7	29	2193	915	3108		
1868–72	Windfall, &c., ...	...	...	...	...	47	13	60		
1872	Thinnings, ...	...	...	...	...	52	57	109		
1872	Total standing timber plus intermediate yield since 1868, ...	...	...	...	...	2444	1387	3831	4·27	4·82
1872	Timber left standing, ...	1632	156·7	4·1	33	2345	1317	3662		
1873–77	Windfall, &c., ...	...	...	...	...	73	18	71		
1877	Thinnings, ...	...	...	...	...	86	158	244		
1877	Total standing timber plus intermediate yield since 1873, ...	....	...	...	...	3146	1494	4640	4·84	4·72
1877	Timber left standing, ...	1289	156·3	4 7	38	3107	1428	4305		
1878–82	Windfall, &c., ...	...	...	...	...	18	17	35		
1882	Thinnings, ...	...	...	...	...	97	44	141		
1882	Total standing timber plus intermediate yield since 1878, ...	...	...	...	...	4264	1456	5720	5·85	4·83
1882	Timber left standing, ...	1144	180·0	5·3	43	4149	1395	5544	...	...

1st Experiment.

C. Unthinned plot.

Year.	Particulars.	Number of trees per acre.	Aggregate sectional area of trees at breast height per acre, square feet.	Average diameter of trees, in inches.	Average height of trees, in feet.	Contents per acre in solid cubic feet. Timber.	Brush-wood.	Total.	Rate per cent. of increment. During each period.	To end of each period.
1862	Standing timber, ...	...	...	...	...	(1631	1092	2723)		
1863–67	Windfall, &c., ...	...	...	...	...	7	4	11		
1867	Dead wood, ...	...	...	...	...	...	...	...		
1867	Total standing timber plus intermediate yield, ...	...	...	...	...	2259	907	3166	3·06	3·06
1867	Standing timber, ...	2421	136·7	3·2	29	2182	913	3055		
1868–72	Windfall, &c., ...	...	...	...	...	40	10	50		
1872	Dead wood, ...	...	...	...	...	11	64	75		
1872	Total standing timber plus intermediate yield since 1868, ...	...	...	...	...	2761	1670	4431	7·03	5·01
1872	Standing timber, ...	2020	170·3	3·9	30	2710	1596	4306		
1873–77	Windfall, &c., ...	...	...	...	...	65	34	99		
1877	Dead wood, ...	...	...	...	...	30	94	124		
1877	Total standing timber plus intermediate yield since 1873, ...	...	...	...	...	3213	1643	4856	2·48	4·12
1877	Standing timber, ...	1646	170·4	4·3	35	3118	1515	4633		
1878–82	Windfall, &c., ...	...	...	...	...	17	12	29		
1882	Dead wood, ...	...	...	...	...	62	78	140		
1882	Total standing timber plus intermediate yield since 1878, ...	...	...	...	...	4194	1514	5708	4·27	4·09
1882	Standing timber, ...	1406	191·8	5·0	40	4115	1424	5539		

The second experiment was in forest in every respect similarly situated, but the positions of the plots, each of which contained 1·3675 acre, was reversed, *a* being at the southern, and *c* at the northern, extremity. The land had been under cultivation up to 1822, when it was sown with spruce fir in strips 2 feet 9½ inches wide and 5 feet 7 inches apart, and oats in the intervening spaces. About 4 years later a very large quantity of the young trees were taken out, and used for stocking other plantations. In 1830, the area was re-sown with spruce, but most of the seedlings that then came up are said to have been killed out by the rank growth of grass.

At the time the experiment was commenced, the trees had reached the age of 40 years, and their crowns were completely closed up, with the exception of three small openings, caused by snow, in the south-west portion of plot *a*. The ground cover consisted, then as now, of dead leaves and moss, with a slight sprinkling of grass.

Plots *a* and *b* contained in 1862 the following stock per acre :—

Plot.	Contents in solid cubic feet.		
	Timber.	Brushwood.	Total.
a, ...	3,040	1,994	5,034
b, ...	2,993	1,938	4,931

The contents of the unthinned plot *c* is not known and cannot be estimated, as it must have borne an entirely different character from the other two.

The following tables show the general results of the experiment :—

2ND EXPERIMENT.

A. Heavily thinned plot.

Year.	Particulars.	Number of trees per acre.	Aggregate sectional area of trees at breast height per acre, square feet.	Average diameter of trees, in inches.	Average height of trees, in feet.	Contents per acre in solid cubic feet. Timber.	Brush-wood.	Total.	Rate per cent. of increment. During each period.	To end of each period.
1862	Thinnings, ...	...	...	...	...	656	697	1353	...	...
1862	Timber left standing, ...	1553	128·6	3·9	31	2384	1297	3681		
1863–67	Windfall, &c., ...	...	...	...	...	176	55	231		
1867	Thinnings, ...	...	...	...	...	164	54	218		
1867	Total standing timber plus intermediate yield since 1863, ...	...	...	...	...	3695	1001	4696	5·00	5·00
1867	Timber left standing, ...	1223	156·5	4·7	42	3355	892	4247		
1868–72	Windfall, &c., ...	...	...	...	...	208	44	252		
1872	Thinnings, ...	...	...	...	...	147	28	175		
1872	Total standing timber plus intermediate yield since 1868, ...	...	...	...	...	4349	1619	5968	7·04	5·72
1872	Timber left standing, ...	932	163·1	5·6	45	3994	1547	5541		
1873–77	Windfall, &c., ...	...	...	...	...	108	55	163		
1877	Thinnings, ...	...	...	...	...	248	106	354		
1877	Total standing timber plus intermediate yield since 1873, ...	...	...	...	...	4936	1536	6472	3·44	4·79
1877	Timber left standing, ...	742	171·6	6·4	50	4580	1375	5955		
1878–82	Windfall, &c., ...	...	...	...	...	47	16	63		
1882	Thinnings, ...	...	...	...	...	326	74	400		
1882	Total standing timber plus intermediate yield since 1878, ...	...	...	...	...	6156	1897	8053	6·22	4·87
1882	Timber left standing, ...	640	181·9	7·2	60	5783	1807	7590	...	...

2ND EXPERIMENT.

B. Moderately thinned plot.

Year.	Particulars.	Number of trees per acre.	Aggregate sectional area of trees at breast height per acre, square feet.	Average diameter of trees, in inches.	Average height of trees, in feet.	CONTENTS PER ACRE IN SOLID CUBIC FEET.			RATE PER CENT. OF INCREMENT.	
						Timber.	Brush-wood.	Total.	During each period.	To end of each period.
1862	Thinnings, ...	...	...	...	...	380	517	897	...	...
1862	Timber left standing, ...	2128	146 9	3 4	29	2613	1421	4034		
1863-67	Windfall, &c., ...	...	...	...	...	126	37	163		
1867	Thinnings, ...	...	...	...	...	189	69	258		
1867	Total standing timber plus intermediate yield since 1863, ...	...	...	...	...	3869	1039	4908	4·00	4·00
1867	Timber left standing, ...	1556	164·6	4 3	40	3554	933	4487		
1868-72	Windfall, &c., ...	...	...	...	...	244	51	295		
1872	Thinnings, ...	..	...	...	...	193	35	228		
1872	Total standing timber plus intermediate yield since 1868, ...	...	...	...	...	4728	1625	6353	7·20	5 32
1872	Timber left standing, ...	1137	174·7	5·3	45	4291	1539	5830		
1873-77	Windfall, &c., ...	...	...	...	...	36	18	54		
1877	Thinnings, ...	...	...	...	...	203	143	346		
1877	Total standing timber plus intermediate yield since 1873, ...	...	...	...	...	5111	1664	6775	3·05	4·42
1877	Timber left standing, ...	882	182·6	6·1	50	4872	1503	6375		
1878-82	Windfall, &c., ...	...	...	...	...	20	8	28		
1882	Thinnings, ...	...	...	...	...	152	12	164		
1882	Total standing timber plus intermediate yield since 1878, ...	...	...	...	...	5425	1326	6751	1·15	3 55
1882	Timber left standing, ...	798	190·4	6·6	53	5253	1306	6559	...	...

2nd Experiment.

C. Unthinned plot.

Year.	Particulars.	Number of trees per acre	Aggregate sectional area of trees at breast height per acre, square feet.	Average diameter of trees, in inches.	Average height of trees, in feet.	Contents per acre in solid cubic feet. Timber.	Brush-wood.	Total.	Rate per cent. of increment. During each period.	To end of each period.
1862	Standing timber, ...	...	...	...	...	...	...	...		
1863–67	Windfall, &c., ...	...	...	...	...	52	20	72		
1867	Dead wood, ...	...	...	...	...	...	...	...		
1867	Total standing timber plus intermediate yield, ...	...	...	...	...	3324	941	4265	...	...
1867	Standing timber, ...	2849	172·1	3·3	35	3272	921	4193		
1868–72	Windfall, &c., ...	...	...	...	...	155	34	189		
1872	Dead wood, ...	...	...	...	...	196	362	558		
1872	Total standing timber plus intermediate yield since 1868, ...	...	...	...	...	4108	2445	6553	9·34	...
1872	Standing timber, ...	2119	198·2	4·1	33(?)	3757	2049	5806		
1873–77	Windfall, &c., ...	...	...	...	...	6	7	13		
1877	Dead wood, ...	...	...	...	...	55	167	222		
1877	Total standing timber plus intermediate yield since 1873, ...	...	...	...	...	4936	2188	7124	4·17	...
1877	Standing timber, ...	1524	208·3	4·9	41	4875	2014	6889		
1878–82	Windfall, &c., ...	...	...	...	...	46	28	74		
1882	Dead wood, ...	...	...	...	...	123	151	274		
1882	Total standing timber plus intermediate yield since 1878, ...	...	...	...	...	6040	1921	7961	2·93	...
1882	Standing timber, ...	1117	200·3	5·7	52	5871	1742	7613	...	...

Two articles are devoted to the Mistletoe, and a third to *Loranthus europœus*. The latter parasite, a native of southern Europe, is said to be extending its habitat northwards.

Forstmeister Meschwitz contributes some notes on the causes of the disease known as "Schütte," which attacks young Scotch fir cultivations, and which he believes to be chiefly due to the effect of late frosts in spring.

Last, but not least, comes a most useful catalogue of works on Forestry and the allied sciences, published during the year 1882, with short critical notices of the more important books by Dr. Judeich and Professor Kunze.

OUTDOOR FRUIT FOR THE MILLION.*

We have received through the kindness of Colonel Wace, Commissioner of Agriculture in the Punjab, a copy of this little pamphlet, which we have already referred to in a previous number of the "Indian Forester." The Author, whose name is not given, but who styles himself "Head Gardener," has experimented on fruit culture in his own property near Bala in Wales for the last 20 years, having originally planted a choice and varied assortment of fruit trees, which in three years' time commenced bearing, and since then has borne annually increasing crops in the most surprising and prolific manner. As an example of this, in 1875, "Head Gardener himself hand-picked three trees with the following results:—The first, a dessert pear of excellent flavour, nailed to a wall 7 feet high, yielded 704 marketable pears. The second, also a pear, yielded 748, and as the fruit was of the preserving order, very large and solid, the crop filled four huge baskets, each one a load sufficient for an average man to lift and carry. From the third tree, an espalier apple, of very moderate size, 700 choice russets were gathered, leaving behind some seven or eight dozen below a regular marketable standard. Thus, from three young and comparatively small trees, no less than 2,152 count of good, sound-keeping fruit was gathered, and as there were some 25 distinct varieties of pear trees in the garden—all fairly well loaded according to their respective sizes and weight of fruit—for instance, one of them, of no great size, whose fruit had easily been forced up to a pound in weight, yielded upwards of 400—the general crop may in some degree be imagined."

The fruit grown consisted of choice varieties of Apples and Pears, Peaches, Apricots, Plums, fruits of the Magnum Bonum going up to a quarter pound in weight, Strawberries, Currants

* Outdoor Fruit for the Million; how to grow it in large and continuous quantity by simple and inexpensive means. Fifth and authorised edition revised and illustrated by Head Gardener. London: F. Pitman, 20, Paternoster Row and Nichols & Co., 29, Oxford Street, 1[illegible]. Price 6d.

and Gooseberries. Black and White Grapes and other tender fruit were grown under glass with similar success.

Head Gardener states that whatever blight destroyed or partially destroyed the fruit prospects of the neighbourhood and country at large never once affected his trees, which his system rendered independent of local conditions.

The scientific explanation Head Gardener gives of his success cannot however be entirely accepted by us, and we should recommend him to study Sach's Vegetable Physiology, though we fully believe in the practical results which will follow a course of treatment similar to his own in the culture of Mangoes, Oranges, Strawberries and Vines, and the other fruit trees and plants which thrive in India. We have indeed experimented with an Orange tree in Debra Dún, and obtained 10 dozen very sweet oranges from it this year, whilst in former years the fruit invariably fell to the ground without ripening.

Head Gardener states that a fruit tree has three sets of roots—

"Firstly, a mass of fibres, that cluster around its stem and are solely for fruit-bearing purposes.

"Secondly, a lot of lateral roots, which travel long distances in search of food for wood formation, and out-balance the fruit fibres which remain closely packed at home, the consequence being, if their growth be unchecked, *much wood and little fruit.* Hence arises the necessity for closely pruning the *wood roots*, an operation which restores at once supremacy to the *fruit fibres*, when much fruit and little wood become the order of the day.

"Thirdly, the tap root, striking downwards to give stability to the tree against winds and storms. Some gardeners, however, consider it a feeder, and prune it when practicable, and to render it so, plant young trees upon slabs of stone, slate or other hard material, which prevent, of course, the tap root from striking downwards." Head Gardener, however, after protracted experiments, has decided that pruning the tap root of fruit trees neither checks the undue growth in a tree's wood or increases its fruit supply, and that from its large size, toughness, and tendency to grow perpendicularly downwards, deep into clay, gravel, and other crude subsoil, where only poor nourishment can be obtained, that its principal or perhaps sole object is to strengthen trees against winds, and that it is a great mistake to prune or meddle with it.

As regards interference with the tap root, we are inclined to agree with Head Gardener, but besides the utility of the tap root as an anchor against storms, it is evident that in the drier parts of India, the great length of the tap root, in the Jand (*Prosopis spicigera*) and the sál, frequently exceeding 60 feet, solely enables the tree to obtain a supply of water during the dry season, unless artificially irrigated.

Of course in orchards where a supply of water is generally

available, this use of the tap root is not of such vital importance as in the case of forest grown trees in the Punjab Rakhs, where the water-bearing strata, during the dry season, is at a very great depth below the surface of the ground.

The mass of fibres which Head Gardener calls fruit fibres, are of course merely rootlets bearing ordinary root fibres, and it is evidently a great object to obtain a large mass of such fibres near the stem of the tree, so that manure and water may be readily and economically supplied to them, as root fibres are the sole absorbers of nutriment from the soil.

The lateral roots, of which Head Gardener complains, also have root fibres near their extremities, and on their own rootlets, and are really sent out by the plant in search of nourishment, and wander further the poorer and drier the soil may be, but these lateral roots have no real power of nourishing the woody growth of the tree, at the expense of its fruit. They, as well as the woody tap roots, consist of conducting tissue, through which nutriment absorbed by the root fibres or feeders is conveyed to the stem, and thence through the branches and twigs to the leaves and buds.

The fact is that, every tree in a natural state tends to form as large a crown as possible before fruiting, and that premature injury of every kind to its organs of nutrition, such as a season of drought, root or leaf pruning, generally hastens the formation of fruit buds instead of foliage buds. As soon as fruit buds have been formed, a supply of strong manure should be afforded to mature the fruit.

By a liberal supply of rich manure to the rootlets near the stem, these increase greatly in number and become densely covered with root fibres, so that the plant is enabled to take up quantities of nourishment in the simplest manner.

Fruit culture is thus seen to be an extremely artificial method of favoring the crop of fruit at the expense of the crown of the tree, which is only allowed to develope sufficiently to hold the greatest possible mass of fruit the tree can be made to yield annually. Having pointed out Head Gardener's misconception of the relation of the lateral roots and root fibres, we will now follow him, as regards the practical methods for securing a large and constant annual fruit supply. He root-pruned his trees every second year or so, in the following manner:—A young non-bearing tree, which was throwing out wood strongly, *was pruned by a sharp spade* thrust deeply into the ground a clear foot or so from the stem. In a few year's time the lateral roots again become troublesome, when a narrow trench should be dug around the tree, 18 inches or so from the stem, and the lateral roots bared and severed, the greatest care being taken not to injure the rootlets and root fibres near the stem.

The appreciation of the distance at which lateral roots should be pruned, is the only little difficulty about root pruning,

but distances of 3, 4, 5 and 6 feet would take in standards and trees of considerable size, the best plan probably being, though Head Gardener does not say so, to prune off lateral roots at a distance from the stem equal to the spread of the crown of the fruit tree after it has been properly pruned.

The main object of root pruning is to weaken the vegetative vigour of the tree, and it should be remembered, that mere branch pruning will not do this, as we see in the case of pollards, the crowns of which are replaced rapidly by strong vigorous shoots, so that after we have thinned out the crown so as to admit light and heat to the fruit, we must reduce the area of the roots, or we shall only have been treating our fruit tree as if we wished it to become a pollard.

The best time for root pruning is said by Head Gardener to be November and December, but Indian gardeners should remember that Oranges are frequently not perfectly ripe till January, and that Loquats blossom at the end of the monsoons, whilst the fruit does not ripen till April and May, so that the time of operating should be intermediate between the fruit harvest and the blosoming, and will be at different periods of the year for different fruit trees.

The method of manuring is thus given by Head Gardener, and should be followed exactly :—

"1. Loosen carefully and draw down the few inches of top soil that cover the fruit fibre space (*Fig.* 1). Then dress liberally with good solid manure, not old weather-beaten stuff with but little nourishment in it.

"2. Put the *top soil* previously drawn down, mixed with a spadeful or so of fresh or moderately fresh lime, on the manure. The tree will then be well nourished for the winter months and prepared for spring blooming."

As regards blights, Head Gardener recommends quick-lime wash applied with a brush to the stems and large branches of fruit trees every third year or so, but he very rightly points out that many supposed cases of blight are due to the exhaustion of the tree in throwing out masses of bloom, when a proper supply of food, in the form of manure, has not been given, so that starvation, and not blight or frost is as a rule the cause of the failure.

As soon therefore as Head Gardener's trees showed for bloom, pails of diluted liquid manure were given occasionally, as long as the blooming process lasted, and after the fruit had set, the trees were supplied once a week with this liquid, this extra feeding enlarging the fruit, improving its flavour, and enabling the trees to crop heavily without exhaustion.

The manures used were :—

1*st*. Drainings of the stable and cow-house, which should have pucka floors properly drained into a reservoir, so that none of this valuable manure may be lost.

2nd. Fresh solid manure of any kind well mixed with water.

3rd. Guano; a few handfuls of this, well stirred up, in a pailful of water, is highly nutritious and easily managed. As regards the labour of manuring, it was found that one man could attend to all Head Gardener's trees in about two hours.

In India, if solid bath-room refuse be placed in trenches, and liquid refuse in large *gharas* for 6 months, with the addition of a few handfuls of lime, it may be readily used for fruit culture, and without any unpleasant odour arising. The sweeper will of course supply the manure after the *mali* has trenched the plants with a small fork so as to avoid injuring the feeding roots.

Head Gardener states that—"under this culture, the trees soon covered themselves with fruit spurs and buds, which in spring threw out masses of bloom, and which, later on in the summer and autumn, yielded masses of fruit; and also, so vigorous did the trees become, that they often bloomed a second, and even a third time, and fruit has ripened in favourable years from the second blooming.

"All fresh shoots, as the season advanced, were rigorously nipped off, leaving only a sufficiency to fill up gaps or for the gradual extension of the tree, and all leaves covering the fruit were unfailingly removed."

Regarding strawberries, which grow very fairly in all Indian districts at the foot of the Himalayas, the following remarks are very useful:—

"The strawberry plant is one that goes greatly to root and leaf in the soft friable soil of the garden, and bears but poorly in consequence. This plant cannot, like a tree, be root-pruned, and a most successful method of treating it was the following, *viz.*:—In a dry time, tramp the plot of ground intended for the strawberry bed as hard, if possible, as a beaten road.

"For (1) soil so hardened checks excess in root growth.

"(2). It retains moisture much longer than loose soil does, an important consideration this for the strawberry plant, whose great natural want is water in abundance.

"(3) Weeds grow both small and slowly in hard ground, and therefore can be more easily kept well under. Next, line out the well-tramped ground in rows 2 feet apart, and in these dig out moderate-sized holes also 2 feet apart from each other. Then half fill these holes with good manure, and next put into each one of them three young strawberry plants (as far apart from each other as the limited space will permit) to form a clump. This done, finish planting with the soil previously dug out, mixed with a little lime. The only ground required to be occasionally stirred (a long-handled spud being the best tool for the purpose) is that within two or three inches immediately round each clump, as by so doing roots gain air, and liquid manure is better absorbed. Then, before winter sets in, say, early in November, put pats of manure over the said clumps, leaving the hard ground round them perfectly bare. This protects the plants

from frost, concentrates food where needed, and stops much indiscriminate waste of manure. Then in spring give the plants some good liquid now and then (say once a week) until the fruit sets. The result will be fruit rich in colour, fine in flavour, and great in abundance. By this method of cultivation, strawberry plants throw out large numbers of unusually fine runners, which must be nipped off as soon as they appear, to prevent the plants from exhausting themselves, except, of course, those required for purposes of propagation."

Head Gardener gives several instances in which, by his treatment, old and non-bearing orchards were made to yield as well as his own, and lest cavillers might say that his trees were located in some warm, well-sheltered, good climatic spot, he tells us that his land is in the very heart of the Bala mountains, where the weather is the reverse of picked, so much so that people thought it too precarious for the growth of fruit.

A remark of Head Gardener's regarding blight must be recorded, it is that "perfectly healthy vegetation grows too fast and exhales strong natural essences which render it an unfitting abode for a pest that only thrives by stagnation and decay; and that blight only fastens on a plant which has been weakened by being deprived of some great natural want or other." We should say that blight is induced by the decomposition of the sap due to the excessive formation of certain chemical ferments in the languishing plant. The theory of the exhalation of strong natural essences cannot be supported for a moment.

Head Gardener gives a useful plan for growing potatoes by placing the sets in rows upon the surface of the ground, and after scattering a little lime over them, covering them first with manure, and then earthing them over with soil. They are dressed with liquid manure after a few weeks, and Head Gardener maintains that by this method, the tubers are properly nourished and protected from excessive moisture of the soil, which is the usual cause of potato disease.

Head Gardener denies, but in this facts and science do not agree with him, that too much manure can be possibly given, as instead of gorging themselves with over abundant food, as some animals do, plants only take what is actually required for their immediate wants. In order to avoid waste of manure, he advocates that the household slops should be poured on to the manure heap, and that half a forkful of solid manure mixed up with water in a pail and well stirred should be used.

Regarding branch pruning Head Gardener says: —

"The following system of branch pruning has been found by Head Gardener to be very easy to do, and very effective when done:

"1. Clear away all dead or diseased wood about the tree.

"2. Prune or saw off all large and superabundant branch-wood, as each branch ought to have full play for itself without being rubbed against, and so damaged by another.

"3. So prune that branches balance well with each other—for then

OUTDOOR FRUIT FOR THE MILLION.

Fig. 1.

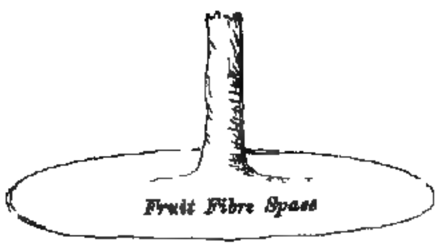
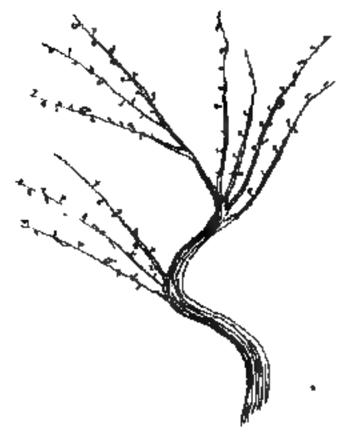
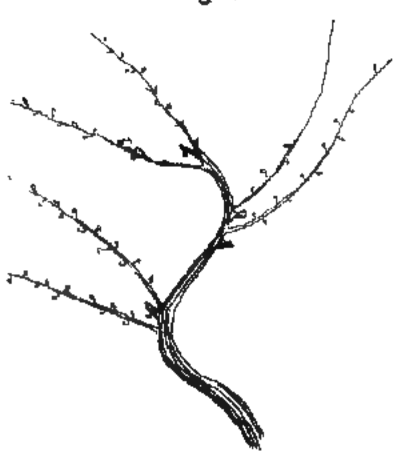


Fig. 2.



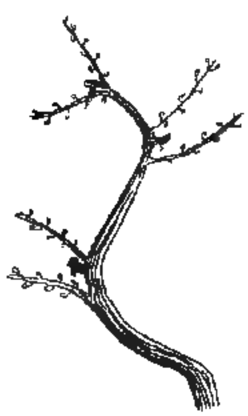
Branch with superabundant new shoots.

Fig. 3.



Branch with superabundant new shoots pruned down to one or two buds.

Fig. 4.



Branch with new shoots left for the extension of the tree pruned down to 8 or 10 buds.

a tree grows gracefully, blooms uniformly, bears better, and is always an object pleasant to the sight.

"4. Prune a standard so that it be, as nearly as possible, hollow in its centre. Sun and air can then penetrate its foliage, and thoroughly ripen its fruit. Besides, the centre wood very seldom bears, and is, therefore, waste. (*Fig.* 2).

"5. Prune away all last year's *superabundant* new shoots (*Fig.* 3) —not level with their branch-wood—but so that one or two eyes or buds be left on them, because these eyes or buds will by-and-bye throw out fruit spurs, which, of course, will greatly increase the crop. New wood shoots left for the gradual extension of the tree prune or stop down to eight or ten eyes. (*Fig.* 4).

"Now the stopping or pruning down forces branches to throw out additional fruit spurs, so that in time a tree becomes literally covered with them. Fruit then follows in great abundance. Prune espaliers and all kinds of fruit trees so that their branch-wood, after the operation, appears to the eye rather thin than not, as over much wood means always but very little fruit."

As we have said before, Head Gardener's theory about fruit fibres is quite fanciful, and the diagrams with which the pamphlet closes are misleading, but we owe him our best thanks for publishing the little handbook which gives the results of his experience, and the practical advice in which can be followed with the best results.

We may note here that Mr. Ollenbach of Dehra Dún has grown oranges and grapes according to the same system for several years, and that there were 600 oranges last year on quite a small tree in his garden.

RHEEA FIBRE AND ITS PREPARATION.

MUCH useful information on the subject of Rheea fibre is to be found in a lecture by Dr. Forbes Watson before the Society of Arts, recently published by the General Fibre Company Limited of London. The rheea plant (*Boehmeria nivea*) and its varieties are common throughout India, and contain a fibre which, when properly prepared, is of much commercial value. To separate the bark from the fibre which underlies it, is the great difficulty which has hitherto impeded its use. But this difficulty appears to have been overcome in a machine invented by Mr. H. C. Smith. The machine is of novel principle, one-half of it being, so to speak, water. It consists essentially of a cylinder provided with projecting ribs, which revolves at high speed before a feeding table. Below the cylinder and at an angle of about 45° a strong flat jet of water is made to pass, in such a way that when the fibre-bearing stalks are fed in at the side the beaters catch and break them up into small pieces, and the jet of water coming from below meets the fibres and beats them clean. The result is that not only is the fibre cleared of its gum,

but there is little or no waste, and what little there is can be made use of in various ways. The fibre so prepared is very clean and of excellent quality. A sample rope made of it was declared by experts to be 7·4 per cent. stronger, and 4 per cent. lighter, than similar rope made of Manilla hemp. The Smith machine not only cleans rheea fibre thoroughly and economically, but is equally effective with fibre plants of all sizes. Leaves and stalks are taken up and operated on without any special adjustment whatever, the character of the action being exceedingly simple and effective. The machine too is easily worked, and one horse-power is sufficient for a machine of moderate size. The quantity of water required is about 400 gallons an hour, but the same water can be used three or four times over, and the refuse water, containing, as it does, the constituents of the plant operated on in the machine, is of great value for irrigating the plant during its growth. It is estimated that a pair of the machines will turn out from 150 to 250 pounds of prepared fibre in a day ; and it appears probable that rheea fibre may be sold in the market at £30 or £35 a ton, the present price being about £50 a ton. Rheea when carefully cultivated yields about 250 lbs. an acre from each crop, and as it may be cropped four times in the year, the yearly outturn is about 1,000 lbs. per acre. Dr. Watson is of opinion that the plant should be cut when about 4 feet high, the fibre at that stage of growth being of better quality than either before or after.

Rheea fibre is said to be adaptable to various uses. It is a good substitute for flax, and even for wools, especially mohair, and the so-called lustre wools. It can also be prepared so as closely to imitate silk.

III. Notes, Queries and Extracts.

THE ASIATIC ELEPHANT IN FREEDOM AND CAPTIVITY.

(*Concluded from page 38*).

DISCUSSION.

MR. A. D. Bartlett said he had had many years' experience of elephants, but only amongst those in captivity. He had had to do with probably the largest one ever seen in Europe, *viz.*, Jumbo. When he came to the Zoological Gardens he was about 4 feet high, and weighed 700 lbs.; at first he was troublesome, but after a very short time became perfectly manageable, and grew very rapidly. This was to be attributed to his good living, and his constant bath in warm weather; in seventeen years he had grown from 4 feet to 11 feet in height. During the last few years of his stay he began to display, during a certain period of the year, a very troublesome disposition, and terrified every one who came near him, except his keeper, Scott, who had extraordinary control over him. Scott was a very curious man himself, and it was with the greatest difficulty he could be induced to allow another man to assist him in the management of the huge animal. But it was feared that on some occasion, if Scott fell ill, or were injured by the elephant, he would be entirely unmanageable, for no other man dared go near him in his house, though when out at exercise he was perfectly quiet. At night, however, he used to tear about, and almost shake the house down, and became such a source of trouble that the Council decided to part with him. He was glad to say that he had recently heard from Mr. Barnum that Jumbo had increased one ton in weight, and was the father of two little infants, and believed it was Mr. Barnum's intention to send over here a female elephant which was expected to give birth to another descendant of Jumbo's in November next.

Admiral Ryder asked if Mr. Sanderson could give any information with regard to the worship of elephants in Siam.

Mr. Wedderburn Maxwell was very glad to hear that the cruel system of taking elephants in pits was condemned, and hoped it would be put an end to throughout India. Having lived in a district adjoining the scene of Mr. Sanderson's operations, he

could confirm all he had said, and thanked him for the very graphic and accurate description he had given of the mode of capture.

Dr. Garson asked if some further information could be given as to the length and weight of the tusks.

Mr. Martin Wood said Mr. Sanderson had assured them that the number of elephants in India was not likely to decrease; but they all knew that in Africa the animal was being mercilessly destroyed, and he should like to ask if any means could be suggested by which the pitiless warfare against this noble beast could be checked.

Mr. Christy said this last point was of great importance. He frequently had inquiries from Africa whether it was possible to organise a body of retired officers, or others, who would go to Africa and assist the planters and Europeans there in devising some means of capturing and taming elephants. They had even gone so far as to authorise the purchase of some Indian elephants for the purpose, if necessary, but up to the present he had not heard of any practical measures being taken, though the matter had been much discussed in the *Field* and other papers.

Mr. Klenck was sorry to hear that there was so much sacrifice of human life in the capturing of elephants. He would also emphasise the remark of a speaker with regard to the cruelty of catching elephants in pitfalls.

Mr. Andrew Cassels thought most persons present were afraid to expose their ignorance on this subject, by making any remarks in the presence of two such authorities as the Chairman and Mr. Sanderson; but he must say that one of his illusions had been removed that evening, for up to then he had always looked upon the elephant as a very sagacious animal.

The Chairman said this was a subject on which he could talk for a long time, though he certainly could not claim to be an authority, and knew very little compared to Mr. Sanderson. As he had listened to the graphic description of the elephants rushing through the primeval forests in the sub-Himalayan districts, he could not help his thoughts reverting from those regions to the valley of the Thames in the time long past, when the very ground upon which they were then met was the *habitat* of elephants far larger than any of those whose dimensions Mr. Sanderson very rightly expressed such doubts about. Most people knew that the Thames valley was, at one time, the habitation of probably two species of elephants, whose remains were constantly dug up in the marshes. Only so recently as 1846, one of those enormous creatures, the *Elephas primigenius*, which was by some supposed to be the ancestor of the modern elephant, was turned up in Siberia, by the action of the water, in a good state of preservation. He was 13 feet in height and 15 feet in length, with enormous tusks, and covered with a long

coating of hair, with a thick matting of wool underneath, showing him to be adapted to a cold climate. The African and Indian elephants were the only remaining examples of a great race which had passed away, though the remains of eight or ten different forms were still occasionally found in certain parts of India, showing clearly marked resemblances to the present type. A quesition had been asked about the African elephant and its capabilities of domestication, and if anything could be done to stop its wholesale destruction. It would be very difficult to suggest anything in that direction; but he might say that, some years ago, the idea did occur to him and others that these animals might be caught and utilised, and he suggested then that Mr. Sanderson should be asked to go from India with a select number of men trained by himself in elephant catching, taking a certain number of elephants with them, and there set up an elephant catching establishment. Had that been done, he felt convinced that long ere this there would have been a number of useful working elephants in Africa. The African elephant was just as capable of being tamed and trained as the Indian, though there were certain differences between them which might be of some practical importance. For instance, he did not know how a mahout could sit on the neck of an African elephant, on account of the immense size of its ears, but there might be other means of driving it. It was quite ascertained, however, that the African elephant was as docile, intelligent, and as capable of doing good work as the Indian, and there was no reason why he should not be utilised in the same way. There was very little doubt that the elephants mentioned in the classic authors, as being employed in the Punic and other wars of Hannibal, and those slaughtered in the amphitheatres at Rome, were of the African species, as was shown by models and drawings, though these were not always perhaps perfectly reliable in details, such as in the size of the ears and shape of the cranium. He hoped the suggestion made, some years ago, by Mr. Sclater and others, as well as by himself, would eventually bear fruit. Certainly such a scheme could be placed in no better hands than those of Mr. Sanderson, for there was no one living who knew more about elephants; and, if a mission of this kind were entrusted to him, within a few years he felt sure he would produce as good a stud of elephants in Africa as could be got in India. He did not know that he should agree with him in all he said, but where he did not, he should defer to his opinion. He confessed he put the animal's intelligence somewhat higher than Mr. Sanderson did, but perhaps this was because Mr. Sanderson had seen them more in the wild state, and might not have seen so much of their after training; but he had certainly seen from time to time instances of intelligence which went beyond what Mr. Sanderson had described. If the elephant fell short of the intelligence of the dog, it certainly

came very near to it, and he could not call the elephant a stupid animal. He should have liked to know something more about the growth of the animal, and when it attained full maturity. He did not think this was yet known and appreciated in India, and he believed that if the *mukhna*, now in the Zoological Gardens, or his female companion, were presented to an ordinary mahout, he would put their ages considerably beyond 15 or 16, which was the undoubted age, because their birthdays were known. He had known them for many years, having come over in the same ship with them in 1876, when they were quite small; but they were now both over 8 feet, and in India such a sized elephant would generally be put down as 20 or 25. He had a certain amount of experience of these animals, from having kept them, known them well, and been known by them. The last elephant he had was a very good one, staunch, faithful, unintimidated in the presence of tigers or any other wild animal, and was about 30 years old, or possibly a little more, when he lost her, with other property, at the time of the mutiny. Several years afterwards, when he returned to India, he happened to go up into Oudh, and in making a journey, part of it had to be accomplished on elephants. When he got out of his carriage to mount the elephant she recognised him immediately, before he recognised her, and he thought that certainly showed a greater amount of intelligence than could be expected from a stupid animal. Another important question was, how to tell the age of an elephant. By looking in his mouth you could tell approximately, but probably not within three or four years. Mr. Sanderson had mentioned an important fact, which was not yet generally acknowledged, that the tusks of an elephant, which did not represent canine teeth, but incisors, were not deciduous, but came once for all, and remained. Comparative anatomists said that these teeth had a deciduous form at first, that they grew for a year or a year and a-half, and were then shed and replaced by the permanent tusks. Mr. Sanderson said this was not so, and though this had yet to be verified, he (the Chairman) thought he might be right. That there was a deciduous tooth which was followed by the permanent one he had no doubt, but apparently it was not shed, but absorbed, which would explain the matter. If they looked into a large elephant's mouth they would see two enormous teeth, double teeth, but not generally more than two, and if they looked into the mouth of one of the elephants in the Gardens now, they would probably see in front of one the fragments of another double tooth. The fact was that the elephant had six molar teeth on each side in the lower jaw, three of which represented the deciduous, and three the permanent teeth; one grew behind the other, and pushed it forward. The first three were lost in the first nine years. At about the 20th to 25th year the fourth tooth was lost, and for the rest of its life the animal depended on the two last. Know-

ing this, you might, up to a certain period, estimate approximately the age. Again the mahouts said they could tell the age of an elephant partly by the general appearance, but what they depended most upon was a fold in the upper part of the ear; however he doubted if they were not frequently out some years. Then there were questions as to the kind and amount of food the animal required, and the best means of keeping it in health. It was laid down in the commissariat of India that, for an elephant at sea, there was required daily 150 lbs. of hay, 20 lbs. to 30 lbs. of flour, a certain amount of rice, 4 oz. to 6 oz. of salt, and 30 or 40 pails of water. The amount consumed by Jumbo was a truss and a-half of hay, two of straw, 2 lbs. of rice, 1 bushel of bran, 1 peck of oats, 7 lbs. of biscuit, grass or green food as much as he could get, and 10 pails of water, so that an elephant was a costly animal to keep. Yet he remembered the time when you could keep one in India, including the mahout and grass cutter, for 30 or 40 Rupees a month. It would cost more than twice as much now. As to the value of elephants, their price was perfectly arbitrary and conventional. You might pay almost any sum for a good tusker or even a good *mukhna*, which was a male with very small tusks like those of a female. If they wanted to see fine specimens of well formed elephants, they could not do better than examine those in the Zoological Gardens, both of which had been carefully selected by men of extremely good judgment and knowledge of the animal. The larger, though the younger one, was a perfectly beautiful elephant, and was selected especially by the late Jung Bahadur, who was a great lover of elephants; on the table was a picture of a very fine tusker which belonged to him, and was considered the finest in India. With regard to ivory and the size of tusks, he had copied some figures on the subject, stating that some African tusks weighed 100 lbs. each, and one pair weighed 325 lbs. It was also stated that the best ivory came from Siam, though why that should be better than the Indian he did not know, as it was the same species. The ivory of the mammoth was even yet exported in tons from Siberia, but whether after being exposed for so many centuries to the weather and water it was of as good quality as the modern ivory, he could not say. He concluded by proposing a vote of thanks to Mr. Sanderson, which was carried unanimously.

Mr. Sanderson, in reply, said he could not give any information about the alleged elephant worship in Siam, for he knew nothing about it. As to the use of pitfalls, he had intended to make it clear that the Government had prohibited them all over India, and though they were still in use in some of the native territories, yet even from these they had had inquiries as to the more advantageous method of catching elephants, and some of these Native States had expressed their desire to abolish this barbarous system. With regard to the length of tusks, he had

himself seen a pair from the Garo hills, in Assam, obtained in 1879, which measured 8 feet 9 inches in length, and he had no doubt they were still in the possession of Lord Lytton, who was then Governor-General. They weighed 168 lbs. Sir Victor Brooke, in Mysore, shot an elephant, one of whose tusks was 8 feet in length, and weighed 90 lbs. As to discouraging the slaughter of African elephants, he feared that nothing short of giving up the use of ivory would bring it about; for as long as the native traders could sell the ivory they would destory the elephants. With regard to the sacrifice of human life in elephant hunting, everything was done to prevent it; but it must be remembered that risk of life was unavoidable in fishing, and indeed in almost all industrial pursuits. Unless the elephant was left alone altogether, there must be some danger, but every possible precaution was taken to prevent loss of life. With regard to elephant catching in Africa, Sir Joseph Fayrer communicated with him on the subject some four or five years ago, and submitted a plan to him. He then suggested that it would be well to send a few Indian elephants over first, to see if they would stand the tsetze fly, because some Indian buffaloes which Dr. Livingstone took there were killed within about ten days' march from the coast. Subsequently four elephants were shipped from Bombay, and landed at Zanzibar; they were under the care of Mr. Carter and another gentleman; but unfortunately, after a few days, they quarrelled with the Indian attendants, who left, and he did not know how they got on. There were accounts sent that they were not at all affected by the fly, and did very well for some weeks or months; then one or two of them died, and subsequently the expedition was cut up. Mr. Carter and the other gentleman were killed, and what became of the elephants, he did not know. As regards riding African elephants, he had three about 7 feet high in the Dacca establishment for two years, with the object of testing them by the side of the Indian elephants, and they were found to be docile, but more stubborn. He had heard the same character of them from the keepers of menageries in England. The men set upon their shoulders, and put their feet behind the ears: if necessary, a pad could be arranged to be kept behind the elephant's ears, to take off the pressure on the rider's legs. It would be a very good thing if the African elephant could be subjugated, because one would carry as much load as 30 or 40 porters, and half the difficulty of African exploration arose from having to take so many, the greater part of whom were carrying goods to be given to themselves and their fellows as wages. Three elephants would be sufficient for any expedition, and this would, no doubt, be the best means of opening up Central Africa. Unless, however, it was decided to settle in the country for some years, he did not see how elephant catching was to be established; the negroes were perfect savages, who regarded an

elephant simply as so much meat ; and so long as the African slave hunters had more profitable employment in their own line, they would not take to elephant catching. It would, therefore, require a permanent establishment. He had made many experiments on the quantity of food an elephant would consume, having kept as many as ten for a month on a stone platform, where everything they had was carefully weighed. They would eat from 650 to 800 lbs. of green fodder in eighteen hours, and the rest of the time they had been out in the jungle getting it, during which time they got a picking also. With regard to their age, the skin of the ear was much relied on by the natives, but it was not always satisfactory, and required to be taken in conjunction with other things. As to the deciduous teeth, no doubt Sir Joseph Fayrer was perfectly accurate, and he was satisfied that they did not shed their tusks. He believed Mr. Corse originated the idea ; whether any elephant ever did so he was not prepared to say, but to test the fact, he had, in a large number of instances, had a file mark put upon the tusk the moment it came through, but although he watched them carefully, he had never known a tusk drop, nor was the idea entertained by anyone in India who was connected with elephants. Mr. Tegetmeier, however, and other naturalists, judging from the skull, asserted that he was wrong, and that elephants had milk teeth. This was no doubt correct, but they were absorbed in the gum.—*Journal of the Society of Arts.*

FLOWERS OUT OF SEASON.—The untimely flowering of trees and shrubs, like the occurrence of the extraordinary gooseberry, is a subject which crops up at such regular intervals as almost to belie the epithet applied to it. Nevertheless, the very frequency of the comment is an indication that the matter is ill understood.

The ordinary time-rate for the production of new cells, new leaves, new flowers, and so on, varies as we see within wide limits. Equally obviously those limitations are imposed by the conjoint effects of inheritance and of external conditions, such as climate or food, or both. An annual plant rushes through its life in hot haste as it were : save and except in the seeds of such plants there is comparatively little building up or maturing of new tissues to be done, and proportionately still less stores of potential food to be accumulated. If, on the one hand, the requirements of such plants are less than in the case of perennials, their exigencies are, on the other hand, more pressing. What they take from the soil, or atmosphere, what power they derive from solar light and heat, must be got quickly or not at all. One illustration of this is afforded by the paucity of annual species in the Arctic regions or at high altitudes. Neither heat nor light is absolutely deficient in such situations, but the length of time during which they are available is too short to allow

annuals to profit by a sufficiently large aggregate to enable them to mature their seeds. Before they can accomplish their purpose, they are overtaken by frost and their activity is put a stop to. The energy of perennials, it is true, may be checked in the same manner, but they have been enabled, before the evil day arrived, to lay up stores of nutriment available for use when the increasing heat and light of the following year shall once more quicken their activity. The work to be done is spread over two or more seasons instead of one, and the chances of success are thus correspondingly enhanced. But if we suppose the conditions to be uniformly and continuously favourable, the abrupt cessation of growth will no longer be manifest, the annual will cease to be an annual, the perennial will not die down in winter, the growing points of the buds will not incase themselves in scales, vegetation will be continuous. Such halcyon conditions find their nearest realisation in moist equatorial climates like that of the Malay peninsula and adjacent islands. But even there the realisation is not perfect. Something happens to disturb the balance; and even if the conditions are generally uniform there is always the idiosyncrasy of individual plants to form a disturbing factor. Again, such conditions, though favourable to the continuance of vegetation, are less propitious to the establishment of fructification. The formation of stem, leaf, flower, even of fruit, is one thing, the maturation of the seed and of the embryo-plant within it is another; and the conditions propitious to either are correspondingly different. The ripe seed makes in proportion larger demands on the plastic matters formed as a result of metabolism, and has almost invariably the same composition according to its species, but this cannot be said with equal truth of any other part of the plant.

Again, the conditions for growth, that is, mere increase in bulk, are different, in degree at least, from those which favour progressive development or metamorphosis. Speaking in general terms, it may be said that vegetation approaches its end where fructification shows signs of commencement. There is indeed no fixed line of demarcation to be drawn, but while morphologically there are gradations and intermediate forms, physiologically there are also transitions, and periods of instability. It is easy to understand how this happens, and how it is the divergences are not greater. These matters indeed partake so much of the nature of truisms, that some apology might almost be needed for insisting on them, were it not that they are absolutely essential for the due comprehension of the phenomena of untimely blooming.

It is also desirable to draw attention to the fact that there is naturally a wide range in the period during which vital activity manifests itself even in individuals of the same species, and as these individuals vary in colour, stature, &c., even when derived from the same stock, so others may vary in their "time-

rates." This is specially noticeable in the case of the horse-chestnut, and is perhaps more often manifest in the form of precocious development in spring than in that of tardy growth in autumn. In most cases the plant has to attain a certain age before it produces flowers, but occasionally we find individuals so precocious that they are scarce out of the seed before they burst into flower. A cocoa-nut has thus been seen in flower while the husk of the fruit was still attached to it. Gardeners, according to their requirements, have freely availed themselves of these individual differences by selecting for perpetuation late or early varieties. The whole subject of the "chronometry of life," it may here be mentioned, formed the text of a valuable lecture by Sir James Paget, at the Royal Institution, many years ago.

Cases of unseasonable blossoming may be ranged under three heads, according as growth and development are: (1) prolonged beyond the ordinary time; (2) premature or manifested aforetime; (3) renewed after a short interval of arrest. Categories (2) and (3) differ in detail rather than in essence, as will be explained further on.

Taking the cases of continuous or prolonged growth first, it is easy to see that many of them are due to a continuance of favourable conditions. A long spell of summer without excessive heat or drought will insure a longer period of blooming; flower will succeed to flower so long as the weather and the natural changes in the tissues of the plant, according to age, are held in abeyance. How small are the exigencies of some plants in these matters may be illustrated by the fact that there are few days in the year when a daisy or a white deadnettle may not be found in bloom, at least in the southern half of England. It is necessary, however, to introduce some qualification, because one has only to look into one's garden to see that in spite of apparently favourable conditions many plants are not to be induced to continue blooming. Although in duration perennial, in the matter of flowering they behave as annuals. Something in their organisation forbids the prolongation of the blooming period. That this is so is at least rendered highly probable by the circumstance that the same reticence is exhibited under cultivation. As an illustration of an opposite character, may be mentioned the prolongation of the blooming period even under relatively adverse circumstances which has been brought about by the art and selection exercised by the gardener. Take roses, for instance, only one of many that might be cited. Our fathers had to be content with what we now call summer roses, roses of great beauty and exquisite fragrance, but which they must have wept to see "haste away so soon." Now-a-days, the case is very different, there is a whole legion of so-called "hybrid perpetuals" marked in the catalogues of the nurserymen as H. P. By their agency a second crop of roses

is assured, while some will continue in favourable seasons to expand their blooms in succession up to Christmas. This prolongation of the flowering season has been brought about by combining by means of hybridisation the robust qualities of European roses with the continuous blooming tendencies of the Indian rose. Many varieties of pear, the common laburnum, the Wistaria, Weigela, the hybrid *Berberis stenophylla*, some rhododendrons, currants (*Ribes*), exhibit this phenomenon, the flowers being produced on the ends of more or less prolonged shoots, as strawberries under like circumstances produce their flowers on the ends of the "runners" of the year.

The premature development of flowers in autumn has a better title to be called unseasonable, because the phenomenon is really due to the unfolding of flowers which, under ordinary circumstances, would remain passive till the following spring. There is not, as in the former case, a new formation or a continuous growth, but merely what the French appropriately call *fleuraison anticipée.* And here for a moment it may be allowable to call attention to an essay of Linnæus entitled *Prolepsis Plantarum*, little read now-a-days, although based on facts, and containing much that is still worthy of consideration. For him a flower was a shoot with lateral outgrowths, a morphological conception that would still satisfy a German transcendentalist. But, further, this shoot and its outgrowths were supposed to represent the outcome of six ordinary years' work contracted into one. A flower was, according to this theory, a shoot in which the differentiation of parts instead of being spread over six years was hurried on and completed within one season. For Linnæus leaves represented the work of one year, bracts that of the following one, sepals of the third, petals of the fourth, stamens of the fifth, and the pistil that of the sixth year. It is not necessary to discuss the morphological aspects of this theory, but it is relevant to our present purpose because it emphasises the relation of leaf-shoot to flower—a relation enunciated about the same time, and independently one of the other, by Wolf and by Linnæus, and thirty years before Goethe propounded a similar notion. Moreover, it brings into prominence not only the morphological relation of shoot and flower, but one manner in which the time of production of the shoot and of the flower respectively may be varied, a subject having an immediate bearing on the question of unseasonable flowering. If, says Linnæus (*prolepsis*, § iii.), "a shrub which has been grown in a pot, and has borne flower and fruit every year, be transferred to richer soil in a hot-house, it will produce for many years numerous leafy shoots, but no fruit. From which it may be inferred that the leaves are produced from the same source whence the flowers previously sprang, and so in turn what now tends to form leaves would, by this agency of Nature, be converted into flower if the same tree were again placed in a pot so as to

confine the roots; hence gardeners desirous of obtaining a more plentiful crop of strawberries, cut the fine roots of the plants in spring before they transplant them, in the hope that they will produce more abundant flowers and fruit." Here we see the same principle laid down as that upon which gardeners act when they wish to secure flower and fruit by cutting off the supplies, and thus making the plant, to a greater degree, dependent on the elaborated reserve stored up in their tissues. This is effected by growing plants in small pots, root-pruning, transplanting, ringing, and other processes, all of which tend to diminish root-absorption, and by disturbing the balance between it and other processes, to check vegetation, and in so far to promote the formation of flower. Charles Martins relates the production on a very large scale of inflorescence on the Agave, in Algeria, as the direct consequence of the excision of the leaf-buds by a troop of French cavalry, who hacked the plants with their sabres as they passed, and thus, by preventing or checking growth in one direction, stimulated it in another. In like manner I have seen flowers produced on the "suckers" of *Ailanthus glandulosa* when the plant was quite young, on the roots of *Pyrus japonica*, and on a sucker of Agave, as the result of injury, probably in all, certainly in some, of the instances.

The frequent production of flowers out of season on newly transplanted trees is accounted for in like manner. But many trees are flowering this autumn which have not been slashed with sabres nor moved by more peaceful weapons. One such tree, a horse-chestnut, I lately (September) saw, in which one limb, and one only, was full of young leaves and flowers, while the remaining limbs were fast losing their foliage. The reason for this partial production of bloom I was not able to divine; possibly it may have had some relation to injury to a certain portion of the root-system in more or less direct connection with the particular branch, but I have no evidence to offer in support of such a guess.

In speaking previously of one modification of unseasonable flowering dependent on activity protracted beyond the customary period, it was mentioned that the flower was in such instances developed at the ends of long slender shoots formed during the course of the summer. In such cases the shoot ends in a flower-bud instead of a leaf-bud as is usually the case. The conditions are no longer favourable for the extension of the shoot, and the energy of growth is diverted to the production of flower. But in the laburnum, in many fruit-trees, such as the apple and pear, the fruits are normally borne on short thick branches called by the gardeners "spurs." These are very interesting physiologically, as possessing intermediate transitional characteristics, such as those before alluded to, between vegetation and seed-production. In form, these spurs are short and thick, with very narrow interspaces between the leaves, and

they bear a cluster of buds which ultimately all develop into flowers, or in which the central and terminal one is a leaf-bud. Internally these spurs are soft and spongy, with a great preponderance of cellular over fibro-vascular or woody tissue. The cells are moreover filled with starch. We have evidently here got to do with store-places, analogous to that furnished by the tuber of the potato and other formations, in which food, or matter capable of conversion into food, is stored up for future use at the growing points; in this case for the formation of fruit. Flowers are occasionally produced on these spurs out of due season: the flower-bud destined for a following season bursts into activity this year, affording an instance of a true *fleuraison anticipée*; but more often, according to my observations, when an untimely flower is produced (especially in the apple), it is from the development of a flower in the central bud of the spur, which is usually a leaf-bud as above stated. In such a case, then, we have not only an alteration in the character of the bud, but a change in the period of its expansion. A converse illustration to that just given is afforded by a case recorded by Mr. Berkeley, in which a bud of a walnut, which in the ordinary course of things should have produced a female inflorescence in the following spring, was developed in the autumn as a leafy shoot.

Renewal of growth after temporary arrest, "recrudescence" as it is sometimes called, occurs normally in the pine-apple, *Eucomis*, Metrosideros, and other plants. Abnormally, I have met with it in *Cytisus nigricans*, the common wallflower, Œnothera, and many others. It hardly differs from the first category mentioned in this note except in the fact that the new growth is the direct continuation of the old and not an entirely new lateral formation. It differs from the terminal bud of a "spur," in that the latter is normal as to position even if developed out of season, whereas in the class of cases now under consideration the activity of the growing point, which usually ceases with the development of the last flower, is exceptionally continued.

One other circumstance deserves mention, and that is the rarity with which true fruit, or at least ripe seed, is produced as a result of these untimely flowers. Some times, of course, ripe seed is produced; a plum is before me as I write, the seed of which is as perfect, to all appearance, as that of the first crop could have been. But in the majority of the pears and apples which come under one's notice at this unseasonable period, the fruit is there (in the popular sense), but the core, which is in a botanical sense the true fruit, is absent, or, if present, the seeds it contains are usually abortive. Botanical readers will readily see the morphological reason why, and physiologists will recognise that in such cases the deviation from the ordinary course is not so great as it appears upon the surface, and the action of

the "environment" is not so potent as it appears to be at first sight.

To sum up: these cases of unseasonable flowering appear to be due either to continuous growth and development, to renewal of growth after a longer or shorter period of arrest, or to the development of a flower-bud in the place of a leaf-bud. What produces these changes? To this no more precise answer can be given than has already been afforded. The absolute nature of the change, structurally and morphologically, depends upon the nature of the inducing causes, and varies accordingly; the degree of change may depend simply on the increased or prolonged intensity of action of the same causes which promote natural growth.—MAXWELL T. MASTERS.—*Nature.*

THE DIFFERENT METHODS OF SEASONING TIMBER.

By William Harrower, *Forester, Cahir Estate, Tipperary, Ireland.*

In countries like our own, where the supply of wood is very limited, the preservation of timber calls for serious attention, and the importance of this subject is shown by the numerous experiments which have been made to determine which system of preservation is most efficacious.

Omitting the attacks of insects, the cause most contributing to the premature decay of timber is alternation of dryness and damp. Timber, when totally immersed in water, or imbedded in any uniform and homogeneous matrix, appears to be nearly indestructible. The piles of Old London Bridge, after being sunk for 600 years in the bed of the Thames, were drawn out in a state of good preservation. Some descriptions of timber are remarkably long-lived (if the term may be used) in a dry situation, from which arises the saying—

> "Keep me wet or keep me dry,
> One thousand years good wood am I."

Unfortunately for the life of felled timber, especially when of large dimensions, it is generally exposed to successive repetitions of dampness and dryness, which speedily effect its destruction, if not protected in some artificial manner against these influences. In a few forest trees, such as teak, the wood is naturally protected against decay by the presence of an essential oil.

The first means tried as a protective was painting the timber, but in a short time this was found little better than useless, and nothing could be expected from an application so completely superficial. The least shrinking of the timber, a violent shock, an incision, or any one of numerous other causes, would be sufficient to produce a crack in the paint, and allow the ingress of the destroying agent. In reality, while the evil was at the

core, the attempted remedy did not penetrate beneath the surface. After the futility of paint as a preservative had been clearly shown, some one hit upon the idea of *impregnating* the wood with a mineral solution, whose properties would be an antidote to decay. In the first application of this idea, the timber was merely soaked in the solution selected, but this operation was soon discovered to be of little service. The protective fluid was either washed out by the action of water to which it was subsequently exposed, or it did not penetrate far enough into the wood to be of any real benefit, especially when the timber was hard and of a close-grained texture. Under these circumstances it appeared necessary to force the preserving fluid into the pores of the wood by hydraulic pressure or other means known to engineers.

Having got thus far, the question practically was—What is the best solution? This question brought out a number of patent remedies in the shape of chemical solutions, and the public were thus enabled to form an opinion which was best. Sulphate of zinc, sulphate of copper, corrosive sublimate, sulphate of iron, and creosote have been applied. In fact, the latter has succeeded so well that "creosoting" has become a generic term applicable to the preservation of timber. The creosoting process is most esteemed in Britain, while sulphate of copper (Boucherie's process) bears a high reputation on the Continent of Europe.

In the various experiments conducted with the view of determining the best solution, a length of time was necessarily occupied, otherwise the results would have been valueless for practical purposes. The number of years that have elapsed since these trials were made, now enables us to form a pretty clear idea as to the most successful process to adopt. No doubt in many instances creosoting and sulphate of copper have failed, but these are exceptional cases, which have probably been caused by the process being imperfectly completed, and it should be borne in mind that the variety of texture in different woods, and the nature of the ground in which they may be laid, modify very considerably the result of the process. With sulphate of copper or any other substance it is essential that the injected fluid should displace the natural sap of the tree, that the antiseptic operation be applied to sound timber recently felled, and that it be subsequently permitted to dry in the open air. In 1848, some timbers which had been duly impregnated with sulphate of copper were laid down in the Ligne du Nord, France, near the station of Compiègne, and when taken up a short time ago were found in a perfect state of preservation. Under the action of the saw they proved to have an excess of hardness over non-preserved timber of the same species, and neither their strength nor elasticity was impaired to any appreciable extent.

The chief modes of decay in timber are known as wet rot and

dry rot, both of which are indirectly due to the action of moisture—in the former by assisting the decomposition of the tissues of the wood, particularly the alburnum or sapwood, and in the latter by aiding the growth of certain cryptogams which obtain their nutriment from the substance of the wood. The reduction of the natural moisture in the wood itself by proper seasoning, and the prevention of the access of external moisture, is to some extent accomplished by a coating of some impervious substance, such as tar. Paint sometimes prevents wet rot, but for the reasons noted above this is not always successful. The same means are generally supposed to destroy, or at least to retard dry rot, but with the same unsatisfactory results. There is this peculiarity, that an excess of moisture is unfavourable to the growth of fungus which feeds on the wood; also, when the circumstances are favourable, such as a moderate degree of moisture, which most woods possess in themselves, and the existence of a warm stagnant atmosphere, no mere coating of paint will prevent the *mycelium* of the dry-rot fungus from penetrating to the interior of the wood. Once this gets effected, its destruction is rapid.

Many opinions are given regarding the season in which timber ought to be felled. Practically the question is settled. The period usually chosen for hardwood, with the exception of oak, which is to be peeled, is from October to March, and conifers all the year round. Objections to felling timber during summer are based on the belief that the wood is full of sap. This, in our opinion, is an error, as in summer the sap lies more on the outside, including the young bark, for the formation of the annual increment of timber. We subjoin a table giving the results of an experiment made in 1867, showing the amount of sap in timber at various seasons of the year:—

January,	...	340 lbs.	July,	...	297 lbs.
February,	...	328 ,,	August,	...	314 ,,
March,	...	331 ,,	September,	...	306 ,,
April,	...	311 ,,	October,	...	328 ,,
May,	...	319 ,,	November,	...	331 ,,
June,	...	297 ,,	December,	...	340 ,,

Remarks.—In this experiment there were twenty-five pieces of timber of equal size cut each month and weighed. The figures show that in the months of November, December, and January there is most sap in the wood, as the blocks are heaviest; while in the months of June and July the weight of the blocks indicates little sap. This can be easily tested, and is worth trying.

There is considerable loss in heavy timber when allowed to split and crack with the drought, and care ought always to be taken to prevent damage of this sort. One great cause of splitting is from allowing the timber to dry too rapidly. In

some parts of England the standing oak is peeled, and after it has stood for some time is cut down under the impression that it is a saving to the wood. This may be the means of preventing cracks, but it involves unnecessary expense. Splitting of wood necessarily occurs where the shrinkage is not uniform throughout, and as the heartwood contains less moisture than the sapwood, the latter shrinks more rapidly. Hardwoods contain about 40 and conifers 45 per cent. of moisture.

There are two methods employed for seasoning timber—the natural and the artificial. The natural, as with everything else, is the simplest, if not the best, being to allow the sap to evaporate of its own accord. The natural can be assisted by carting the timber as soon as felled into sheds, and having it cut into logs and stored within shelter for eight or ten months; after which it should be sawn into planks. Great care should be taken not to allow the planks to lie too close when ricked, but to have a passage of air freely circulating through them. The artificial system consists of the application of heat or liquid. One plan is to place the timber in a tank having an air-pump attached, which is supposed to draw the fluid from the interior of the timber. To increase the tendency of the sap outwards, a higher temperature than that of the atmosphere may be applied with less risk of rending. By this process the timber can be seasoned in a few weeks. Of course there is considerable extra expense incurred, as an engine is required to work the pump, and it frequently happens that the wood is imperfectly dried. We advocate the natural process above all we have yet seen and tested. In both cases casting or twisting ought always to be guarded against. Some kinds of wood are more liable to cast than others, and we have seen the same kind grown on different places very different in the grain. The best examples of well-preserved timber are found in the roofs of churches. The roof of Westminster Abbey is set down at over a thousand years old, yet the timber is quite sound. Hence it at once appears that the best method is to keep it as permanently exposed to the free action of the air as possible. No doubt in this department science has done much to save time and expense.

The decay of timber, in our opinion, arises from internal moisture, as already stated; therefore the work of greatest importance is to expel the sap and keep the wood permanently dry. There are several paints recommended for this purpose. An oil taken from tar is much sought after as an unequalled preservative for outside timber, such as railway sleepers, fence posts, bridge piers, &c. The usual way of applying it is to fill a tank with well-seasoned timber, and to the tank is attached a pump worked by steam. The oil is pumped into the tank, and a high pressure of oil is supposed to find its way into the pores of the timber. Force is the power required in this system, without which the process is unavailing. Green wood placed

in the tank and treated in this manner receives little or no benefit; we are inclined to say it does more harm than good, as the internal moisture is pressed into the centre, and the pores being filled with the oil, it cannot escape; hence internal decay ensues. When the wood is thoroughly seasoned and placed in the tank, hot air ought to be first employed to open the cells; then under high pressure oil will penetrate into the centre, as we have seen railway sleepers saturated completely through. A plug in the bottom of the tank, with a connecting pipe to the reservoirs where the oil is pumped from, can be opened to drain off the oil, and by the application of hot air the wood is rendered dry, and can be handled comparatively clean. We have seen this method wrought with beneficial effect, though often with the opposite result, according to the amount of previous seasoning.

In ordinary circumstances, tar is the most economical preserving paint for estate purposes. Wire fence posts are frequently coated with tar previous to being set in the earth. Here we would recommend two tanks or wooden troughs about 20 feet long, 3 feet broad, and 2 feet deep, to be filled nearly to the top, so that the liquid may not be lost by running over the sides when the posts are put in; the posts are set on end as close as possible, and the tanks emptied alternately, thus allowing some time for the fluid to penetrate the wood, a process requiring no skilled labour. A scaffold is erected close to the tanks upon which the posts are laid out to drip, and the fluid runs into the tanks again. The advantage of this system over the charring method used for the same purpose is that one labourer can easily smear from one to two thousand posts per day. Our own system is to cut the wood into posts as soon as felled, and stack it until perfectly dry; to allow ample time we always have it prepared a year beforehand. If larch is thus treated, it is exceedingly hard and durable, and capable of resisting the encroaches of damp for a long period.—*Timber Trades Journal.*

THE BORING OF MARINE ANIMALS IN TIMBER, &c.—Professor M'Intosh, St. Andrews, delivered a lecture in the committee-room at the Forestry Exhibition on "The Boring of Marine Animals in Timber, &c." There was a large attendance, and the chair was occupied by Lord Provost Sir George Harrison, who introduced the lecturer.

Professor M'Intosh began by stating that the burrowing of marine forms was a feature familiar to every zoologist, for scarcely a dead shell could be dredged from the sea bed that was not perforated by boring sponges. In the same way the surface of the limestone rocks of our southern shores was riddled by those sponges. So far as at present known, sponges bored only in calcareous substances, and there was a difference of opinion as to whether the agent in boring was the spicules or

the soft animal jelly of the sponge. As regarded the boring of the purple sea urchins in gneiss and granite the teeth were the main agency in the perforations.

The group of annelids included many boring and burrowing forms, some perforating sand and others earth; while many bored in aluminous shale, sandstone, limestone, shells, and various substances. Each form, moreover, made a characteristic tunnel in the rock, so that the borer could in most cases be determined. None, however, bored wood, and though pieces of telegraph cable had been several times sent him, with accompanying annelids as the depredators, in no instance had the lecturer been able to connect them with the injury.

There could be little doubt that those forms performed a useful function in the disintegration of dead shells and in corroding the surface of calcareous and other rocks. The crustaceans and the molluscs were groups that were conspicuous in the perforation of wood and allied materials. Of crabs, the *Cheluria terebrans*, a form less familiar to Scottish zoologists than to their southern colleagues, was in xylophagous powers even more destructive than the common Scotch boring crab—the gribble—its excavations being considerably larger and more oblique. Though the gribble *Limnoria lignoram*—must have been familiar to observers from a very early period, it was first described by Dr. Leach only in 1811, when Mr. Robert Stevenson, the celebrated engineer, found it burrowing most destructively in the large beams of Memel fir supporting the temporary beacon on the Bell Rock. Other logs of pine on the rock were reduced at the rate of about an inch a year, and the house timbers were so much destroyed by the gribble that many stood clear of the rock, supported only by the iron bolts and stanchions. It attacked all kinds of submarine woods; and the late Dr. Coldstream, Leith, had told them that in 1825 so extensive were the ravages of this creature that many of the piles of Trinity Chain Pier had to be replaced after four years' service, and studded all over with broad-headed nails from the base to the limit of high-water mark.

Having described the structure of the gribble and its mode of boring, the lecturer said it had also acquired the habit of perforating the protecting envelopes and gutta-percha, in which submarine telegraph cables were sheathed. The work of the burrowing crabs, however, was quite overshadowed by the far more serious encroachments which the boring shell-fishes were capable of making in timber and similar substances, as well as in rocks of various kinds.

Professor M'Intosh pointed out the boring of the pholas and date shells in rocks, and went on to describe the destruction caused by xycophaga, which was to be seen in the deep water off the Firth of Forth and elsewhere in England and Scotland. It was, he said, a little bivalve shell-fish or mollusc, intermediate

in structure between the stone-boring pholas and the strictly wood-boring teredo. There was very little externally in the wood attacked by this form to attract attention, except the presence on the surface of minute apertures, which indicated the points by which the young animals had entered ; but on breaking open the wood the adults were found in smooth tunnels in every fragment large enough to afford a lodgement.

The most conspicuous genus of wood-borer, however, was the teredo or shipworm, species of which occurred in every ocean. In the tube of the teredo the annelid (*Nereilepas*) was often found, and some observers maintained that it was the destroyer of the teredo, but the lecturer had some hesitation in subscribing to that theory. The very same species of annelid occurred abundantly along with the common hermit crab in the shells of the great whelk, and the association of annelids with other forms in tubes or elsewhere was extremely common ; but it was not for the purpose of preying on their neighbours, though the bodies of their hosts were in many cases softer than those of the teredo ; they were what zoologists called messmates—dwelling in association with other animals. The object in life of all the species of teredo was to bore ceaselessly into timber, the tunnels in which varied from one to two feet in length in the case of the common teredo to fully a yard in the great teredo.

Professor M'Intosh then gave a brief outline of the history of the teredo, which appeared to be mentioned for the first time in the "Knights of Aristophanes" and said that the French and Dutch suffered much more seriously from its ravages than we did. The theories that had been brought forward to explain the mode by which marine animals perforated material so different as wood, limestone, wax, granite, and aluminous shale, might be ranged round two great centres—the chemical and the mechanical. The advocates of the chemical theory seemed to take it for granted that the borings occurred chiefly in calcareous substances, and with propriety, therefore, they made their solvent an acid. That notion, however, was unable to explain the perforations in media totally impervious to such action ; while no trace of acid was found in many borers, and while present in some, it was likewise characteristic of other marine animals that did not bore. The mechanical theory, again, supposed that the animals perforated by means of shells or gritty particles in the case of molluscs, of teeth in sea-urchins, bristles in annelids, and horny processes in certain sea-acorns and gephyreans ; but they were left in doubt concerning the extensive and wonderful excavations of the sponges, the bryozoa, and the rest of the cirripedes.

Alluding to the methods of protecting submarine timber from the ravages of such animals as he had been speaking of, Professor M'Intosh said different kinds of wood were mentioned as

being impenetrable by such boring action, but so far none had been successful. There were many preparations for the treatment of the wood before immersion. Soluble bitumen, silicated lime, and various compositions had each in turn been tried externally; while silicate of lime, creosote, and other fluids had been forced, under great pressure, into the tissue of the woods. The experiments of the Dutch Commissioners, who investigated the matter, had led them to the conclusion that no external protection other than metallic sheathing or the studding of the wood with broad-headed nails would be successful in resisting the attacks of these borers, while the only impregnation they found reliable was creosoting.

In conclusion, Professor M'Intosh pointed out that while the Dutch, French, and other Commissions had done material service in regard to the best means of protecting timber from the attacks of borers, the subject was by no means exhausted. On the contrary, it would form a fitting object for research at the marine laboratories which at last, he was glad to say, were being established on our coast. That ceaseless boring of wood was not, however, an unmitigated evil. The masses of timber swept seawards by many foreign rivers would prove a serious impediment to navigation if the marine borers did not slowly but surely accomplish their dissolution. In the same way the relics of many a ship in the depths of the sea were disposed of, and even utilized for the increase of animal life, which was, directly or indirectly, connected with the food of fishes, and, consequently, with the welfare of man.

The lecture was illustrated by a series of spirit and dry preparations and coloured drawings; and at the close a cordial vote of thanks was, on the motion of Professor Heubrecht, Utrecht, awarded to Professor M'Intosh.—*Timber Trades Journal.*

FORESTRY STATISTICS.—According to an article in the *Journal of the Society of Arts*, the following are the forestal statistics of the chief countries of Europe. Russia has forests extending to 527,426,510 acres, or 42·38 per cent. of her whole territory; Sweden has 40,636,883 acres of forest, or 40·43 per cent.; Baden, 1,337,767 acres, or 35·90 per cent.; Austria, 23,284,174, or 31·39 per cent.; Wurtemburg, 1,494,147 acres, or 31·22 per cent.; Hungary, 19,425,600 acres, or 28·24 per cent.; Prussia, 20,047,014 acres, or 23·35 per cent.; Norway, 17,290,000 acres, or 22·30 per cent.; Switzerland, 1,905,407 acres, or 18·64 per cent.; France, 20,641,953 acres, or 15·79 per cent.; Belgium, 1,073,452 acres, or 14·82 per cent.; Italy, 9,031,310 acres, or 12·34 per cent.; Holland, 486,229 acres, or 6·27 per cent.; and Denmark, 364,474, or 4·25 per cent. But the United Kingdom is less than the least of these. The ratio of woods to the total acreage is 3·7 per cent. Ireland has 328,473 acres

of wood-lands, or 1·62 per cent. of its total area; Scotland, 734,490 acres, or 3·7 per cent.; and England, 1,325,765 acres, or 4 per cent.

On the other hand, the supply required by this country is enormous. The value of forest products imported into Great Britain is little short of 50 millions sterling. Of this sum about 20 millions are spent for timber alone. Our largest supplies are drawn from British North America, the United States, Sweden and Norway, Russia and Germany. These consist chiefly of fir logs or deals; but we receive teak from Bengal and Burmah; mahogany from Honduras, British Guiana, and Mexico; rosewood, walnut, and satin-wood from the United States, Brazil, and Turkey; and logwoods from Hayti and St. Domingo. £182,000 are expended in the imports of living trees and shrubs from foreign countries, ranging from Belgium to Japan, and £57,500 for tree and garden seeds. Sufficient has been said to show the importance of forests in every point of view—climatic, agricultural, economic, and commercial.

Apart from timber, the forest products are numerous and valuable. Take, for instance, the importation of fruits and nuts alone; these are valued at nearly eight millions. Palm and cocoanut oil sent from the West Coast of Africa, India, and the islands of the Pacific, is worth more than a million and a-half; olive oil, from Italy, France, Portugal, Spain, and Turkey, nearly a million. Caoutchouc is imported from Brazil, Africa, India, &c., to the value of nearly three millions; and gutta percha is got from the East Indies to the value of over half a million. Again, take Peruvian bark, from which quinine is made: nearly two millions are paid to India and Brazil for it, whilst four millions sterling are sent to India for dye-stuffs. Gums to the value of a million and a-quarter are imported from Egypt, New Zealand, India, and Brazil; and turpentine and pitch, valued at a million and a-half, are used in Britain from the forests of the United States, Russia, Germany and France. —*Paper Makers' Monthly Journal.*

THE following is from the *Colonies and India*:—Within the last twenty years a vast extension of the economic uses to which this valuable fibre [cocoa-nut fibre] is put has taken place. The term "coir," usually applied to this material, is the Anglicised form of the South Indian "kayaru," cord or twine, and is not applied in India to the raw fibre, which is called in the Tamil language "savuri." The fibrous husk or rind of the cocoa-nut is easily stripped from the nut while yet green, by striking it on the point of an iron spike, and then is steeped in salt or brackish water, where it lies for several months, until the softer portions of the husk rot away, and the strong fibre alone remains. This is taken out, beaten with a stick to separate and clean the fibre, and twisted with the required number of strands into rope, or

woven into matting, while the stiffer fibres are made into brushes and other articles of domestic utility. The fibre is pressed for shipping into bales, weighing 200 lbs. each. The attempt has been made to prepare the fibre from the dried husk in England, but without success.

Large profits have been made in this manufacture in India. But it can now be carried on so much better in England, with the machinery and appliances available here, that large quantities of the yarn are exported. One firm in Lancashire have introduced steam loom weaving of this material. The various shades of fibre—cream-coloured, reddish brown, and blackish—which vary greatly according to care and skill in preparation, are first carefully separated, and cocoa-nut matting is now made of fine quality with pretty shades of colour and in pleasing patterns, so as to be available for higher uses than the very coarse makes, and the material is most durable. The yarn is also plaited by machinery into sinnet or belting.

Cables made of coir, bear exposure to salt-water better than anything else, the tannin which it contains preventing the fibre from rotting; they are exceedingly light and buoyant, as well as elastic. Coir cordage, in Dr. Wright's experiments, broke at 224 lbs. weight. Even the refuse and broken fibre can be turned to account for stuffing mattresses, and is used in horticulture, &c., as no insect will touch it.

The exports from Travancore of this material form a large proportion of the trade of the district, and amounted, in 1879-80, to nearly 150,000 cwt., valued at 13¾ lakhs of rupees (say £137,290), and paying to the Government a duty of Rs. 68,000. Of the cocoa-nuts themselves, nearly 9,000,000, valued at nearly Rs. 2,60,900, and paying customs duty Rs. 13,000, were sent away. Other products of this palm exported as oil and copra or dried kernel, were valued, the former at Rs. 3,22,100, and the latter at no less than 26½ lakhs of rupees, making a total value of the export of products of the cocoa-nut palm, from Travancore alone, of 46¼ lakhs of rupees (nearly half-a-million sterling). Some thousands of tons are also exported from Cochin.

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SOUTH AFRICAN INDUSTRIAL EXHIBITION.

(Continued from page 54).

16. Podocarpus elongatus (l'Herit)—Outeniqua Yellow-wood.
Exhibits: 1 round block, 1 square log, 1 plank (5 feet long) and 1 veneer; seed.

This tree attains the largest dimensions of any in the Colony. For its diameter, it is not a very tall tree, nor has it much length of bole; but its massive trunks are a striking feature in all the best forests of the Colony. Bark, thin, scaly, almost black, peeling off in pieces like a child's puzzle map. The wood is of a light yellow colour, like deal, but closer in the grain, more absorbent and tougher than deal. Both of the colonial yellow-woods take an excellent stain and polish; and can be got up to imitate walnut, mahogany, &c., with great facility.

Yellow-wood is extensively used in the Colony for beams, planks, flooring boards, and the more common furniture. Outeniqua or "Bastard" yellow-wood, as it is called in the Amatolas, has of late fallen somewhat out of repute, on account of the facility with which it is attacked by "dry rot;" but this disease arises principally from want of ordinary care in seasoning, and the felling of the timber out of season. There still remain many fine specimens of these beautiful and stately trees in the forests of the Knysna and the Amatolas, as the bush-cutters have preferred to fell the smaller and more easily-handled timber, rather than encounter the labour and difficulty of sawing and slipping these monsters. At Knysna it appears to be a tree that reproduces itself less easily than Upright Yellow-wood, young trees and seedlings of the Outeniqua being rare. In the Amatola Forests seedlings of Outeniqua and Upright Yellow-wood are reproduced naturally under dense shade.

It has been observed that this tree grows straighter and generally taller on steep ground, but the trees with the greatest circumference are usually found on more level ground. One of the largest trees measured at Knysna was 23 feet in circumference and 80 feet in height.

In the Amatolas, trees of this size are more common. The largest tree measured there ("The Eastern Monarch") has a girth of 30 feet, a bole 40 feet in length, and a total height of 90 feet. But this tree, on account of its small length of bole, does not contain more than 3,000 cubic feet of timber, a total which has been considerably exceeded by trees of smaller girth but greater length of bole.

Both of the common Yellow-woods (Podocarpus) have the clean, straight boles characteristic of conifers, but crowns which, with their gigantic, spreading limbs, recall rather the appearance of the British Oak of parks and avenues.

These massive crowns are especially characteristic of the Outeniqua Yellow-wood. More even than other trees with large bushy heads, the "reducing-factor" for yellow-wood boles makes a near approach to unity. Cases occur occasionally where the top girth of a bole slightly exceeds the girth at 5 feet from the ground. Yellow-wood, very much more than any other species, is festooned by the long, beard-like lichen, which is so characteristic a feature in South African forests.

Very large and heavy trees are sometimes overturned by the winds, but average-sized trees seldom, as the roots are of a great size and length.

The crown of a full-grown Outeniqua averages about 60 feet in diameter. When dry, its wood loses about half its weight. A cubic foot of Outeniqua Yellow-wood weighs 40·15 lbs.

The quantity marked in the open sections of Knysna in 1884 is as follows :—793 trees, containing 61,621 cubic feet squared timber, value £256 0s. 7*d.*; average consumption for preceding years, 7,330 cubic feet.

17. *Podocarpus latifolia* (l'Herit) —Upright Yellow-wood.

Exhibits : 1 plank (13 feet long), 1 block, 1 veneer.

This tree does not attain the huge size of the preceding. Its bark is whitish grey, with a fibrous appearance not unlike that of many pines. Wood, a light yellow, of shorter fibre and closer grain, but hardly distinguishable in appearance from the wood of the *P. elongatus.*

Unless cut in the proper season, Upright Yellow-wood warps and splits badly; but it is straight-grained, and works well either with a plane or saw. The trunk of the tree is remarkably straight, and does not bifurcate to the same extent as Outeniqua Yellow-wood.

The spread of the crown of a full-grown tree is small in proportion, seldom exceeding 30 feet, usually much less, especially when surrounded by other trees. The branches, compared to Outeniqua, are thin and light, so that the tree does little damage in falling; it grows readily from seed, small trees being usually abundant in the forest.

Under favourable circumstances, the average height of an

Upright Yellow-wood tree is about 75 feet when mature, and the average length of bole about 23 feet, though some specimens have been seen without a branch for 50 feet; the average diameter of mature trees seems to be about 23 inches, though some are found occasionally much larger. The roots of Upright Yellow-wood are not usually extensive, and the tree is frequently blown down by violent winds.

The Upright Yellow-wood grows its best on tolerably steep ground. Like nearly every other conifer, neither of the colonial Yellow-woods are coppicers.

This species, together with the Outeniqua, represent at least 50 per cent. of the trees which compose the forests of George and Knysna, and the proportion is nearly as large in those parts of the Amatola Forest, which have not been worked.

In the Gouwna Forest at Knysna the Upright is more plentiful than the Outeniqua, and, as a rule, not very much smaller. In the middle of the forest, the Outeniqua nearly disappears; but the Upright continues abundant and healthy; natural reproduction would be more successful if the forest were thinned out.

Both the Outeniqua and Upright Yellow-wood have been cut up into railway sleepers, with unsatisfactory results, as regards durability, when placed in the ground unpickled. A contract entered into by Government for the supply of 500,000 sleepers had to be cancelled on this account.

Experiments are being made now with creosote-injected sleepers. If this should prove satisfactory (of which, up to the present, there is every prospect), large sums of money, which at present go to purchase sleepers from other countries, would be saved to the Colony.

The weight of a cubic foot of Upright Yellow-wood is—*
Marked for felling, 5,555 trees; cubic contents, 111,882 feet; value, £1,400 5*s.*

18. *Olea laurifolia* (Lamk) —Ironwood.

Exhibits: 2 round blocks, 2 small planks (16 inches), 1 square block, seed, bark.

A tree from 30 to 35 feet high, and from 2 to 3 feet in diameter. It sometimes attains a height of 50 and a circumference of 6 feet. Bark whitish, smooth; wood very hard; distinction between sap-wood and heart-wood very pronounced; sap-wood white, heart-wood almost black.

The trunk is always single to a height of about 20 to 24 feet, and throws out a good many branches; the spread of the crown is about 24 feet, and the shade given rather dense. The berries of the Ironwood are very numerous, and drop in the month of June. They are of a bluish, plum-like colour, and much eaten

* This figure is omitted from the original report.—[ED.]

by birds, wild pigs, &c.; they are about the size of an olive berry.

Ironwood is not often seen to be rotting outside, but if mature trees are cut down, many will be found unsound in the heart though not necessarily hollow.

The proportion of sap-wood to heart-wood is most variable, but generally large; the sap-wood is very white, and rather soft when green; the heart-wood is very dark, and hard when green. When the sap is up, the heart-wood and sap-wood are very readily separated.

A well-grown Ironwood tree will be about 21 inches in diameter, with a good working length of 21 feet.

The roots of Ironwood are not very large, and the tree is frequently blown down.

This wood is used for wagon work, telegraph poles, and piles and posts for fencing. Abundant in the forest of George, Knysna, and Humansdorp, and throughout the greater part of the Colony.

Weight of a cubic foot, 64·168 lbs.

19. *Curtisia faginea* (Ait)—Assagai.

Exhibits: 1 small plank, 1 veneer, 1 square log (on wagon), 1 round block, bark.

A tree from 30 to 40 feet high, and from 1 to 2 feet in diameter; but is seldom straight for more than 14 to 18 feet. Bark thin, black, almost smooth. The crown in single trunks is about 17 feet in diameter, but the stem frequently bifurcates, and the crown may then cover 25 feet. Bifurcation often leads to unsoundness in one of the stems. Wood, of a bright red colour, extremely tough and strong, heavy and elastic, close-grained and very durable.

It answers well for all kinds of superior furniture, tools, &c., but is truly invaluable and not to be surpassed by any other wood in the construction of wagons, particularly in this country, where the natural difficulties of the roads, the great distances to go, and the excessive heat of the climate require strong and substantially built vehicles for travelling.

This valuable tree is becoming very scarce in the forests of George and Knysna, though it is to be found throughout the Colony generally, and is abundant in the Zitzikama.

Flowers in January and February; berry round, fleshy, 4-5 seeded. These berries of the tree ripen about the beginning of September.

An Assagai tree may be considered as mature when it attains a diameter of 19 inches at 3 feet from the ground. If it is a single trunk and has no unsoundness or injury in youth, it should attain this size with a fair working length of 22 feet, and 16 inches diameter in the middle, which will give cubic contents of 30·75, which may be considered as an average example of good growth under favourable circumstances.

20. Cunonia capensis (Lin)—Red Els.

Exhibits : 1 plank 5 feet, 1 plank 3 feet, 1 veneer.

A large tree, from 30 to 60 feet high, and from 2 to 3 feet in diameter ; bark wrinkled, black ; wood of a rich red colour, hard and tough ; lasts well in the ground.

The tree has an ample crown, but a somewhat branching trunk. It throws a rather dense shade, and in the Amatolas is most common on the edge of the forest.

The timber is greatly prized for furniture purposes, and is extremely handsome. It takes an excellent polish.

It is valuable as a wagon wood and for other purposes.

Weight of a cubic foot, 47 lbs. Flowers in January ; in the Amatolas in April.

21. Platylophus trifoliatus (Don)—Witte Els.

Exhibits : 1 plank 3 feet long, 1 plank 5 feet long, 1 veneer.

A tree from 30 to 40 feet high, and from 2 to 4 feet in diameter. Wood yellowish, white, hard, and tough.

For durability, this wood has the highest name next to the Wild Olive in the Colony.

Timber cut from the lower parts of the tree has a fine twisted grain ; when sawn into planks is very handsome, and takes an excellent polish. The roots are particularly beautiful for turning purposes.

It is a favourite wood for boat-building ; grows only in kloofs, but is fairly plentiful, and lasts a very long time in the ground.

Weight of a cubic foot, 38·168. Cost of working, 1·25 ; flowers in January.

22. Elæodendron croceum (DC.)—Saffron.

Exhibits : 1 small plank, 1 veneer, seed, bark.

So called from a yellow resinous coating that covers the inside of the outer covering of the bark. A tree from 50 to 60 feet high, and from 2 to 3 feet in diameter. Bark whitish. The thickness of the bark is a little less than an inch.

The wood is hard, tough, and close-grained, and a very pretty light red shade. It has been used for boat building with success.

It takes a very fine polish, is easily worked, being straight in the grain. It seasons well in the log if squared.

It is an excellent and handsome wood for furniture purposes, and is principally used in wagon work as fellies.

The proportion of sap-wood is about one-eleventh of the diameter. Judging from a few specimens, the crown may be said to average 35 feet in diameter. The bark of the saffron tree is said to be the best in the country for tanning purposes, and the practice of barking the trees while they were still standing led at one time to the destruction of many of them, principally in Kaffraria.

Rare in the forests of George and Knysna, but fairly plentiful in the Zitzikama, the coast, and the Amatola Forests. Flowers in June and July.

Weight of a cubic foot, 54 lbs.

23. *Pterocelastrus variabilis* (Sond.)—Kersehout.

Exhibits: 2 veneers, 1 small plank, bark.

A tree from 30 to 40 feet high, and from 1 to 1½ feet in diameter; bark thin, dark grey; stem generally ribbed, tough, tall, and straight; wood of a handsome dark red, hard and heavy, and of a fine grain. It contains an extraordinary amount of sap, which entails extra care in seasoning, as it warps very badly unless thoroughly dry. Is sometimes used as wagon spokes; now used for harbour piles. Is said to resist the action of the *teredo navalis* better than any other species. The bark is used for tanning.

A fair average sample of Kersehout will give a log of 20 feet, with a diameter of 15 inches in the middle—24·540 cubic feet. Common in the forests throughout a great portion of the Colony. Flowers in October.

24. *Pterocelastrus rostratus* (Walp)—White Pear.

Exhibits: 2 small planks, 2 blocks.

A tree from 20 to 30 feet high, some often reaching 65 to 75 feet. The timber splits badly, but seems to be strong across the grain, and it is therefore used for wagon fellies.

Bark whitish grey, smooth and thin, presenting a variegated surface of red, white, and brown. Wood hard, close-grained, and heavy.

The diameter of the crown of a full-grown tree is about 18 feet. The tree is usually very straight and clean; the trunk is seldom cylindrical except in young trees. When they attain full size, they often throw out a number of shoots at various heights from the ground.

Is comparatively scarce. Grows chiefly in the forests of the Swellendam and Uitenhage Districts, but is also found on elevated rocky places in the woods on the eastern side of Table Mountain. Flowers in September and October (Pappe).

25. *Olinia capensis* (Kl.)—Hard Pear.

Exhibits: 1 veneer, 1 plank 3 feet long.

A tree from 25 to 30 feet high, and from 2 to 3 feet in diameter. Bark brown, rugged; wood yellowish, very hard, tough, and heavy, like the European White Birch. Is used in wagon work and for railway sleepers.

Common in the forests and woods throughout a great portion of the Colony (Pappe), but very scarce in the George and Knysna, only growing within 3 or 4 miles of the coast (Hawb.).

Weight of cubic foot, 68 lbs. Flowers in July and August.

26. *Eckebergia capensis* (Sparrm)—Essenwood.

Exhibits: 2 round blocks, 1 veneer, 1 plank 3 feet.

A tree from 40 to 50 feet high, and from 2 to 3 feet in diameter, with a spread of crown of about 20 feet.

Wood white and soft, resembling ash in appearance. Is said to rot with great rapidity if left lying on the ground.

Found in the principal forests of the George, Uitenhage, Albany, and Victoria Districts. Is very scarce in Knysna, but found in any quantity along the coast.

Flowers in August. Weight of a cubic foot, 8 lbs.

(*To be continued*).

A GLANCE ON THE PLANTS OF TASMANIA.

Communicated by Baron Ferd. von MUELLER, K.C.M.G., M.D., F.R.S., F.G.S. *&c.*

IN offering some brief notes on the vegetation of Tasmania for the benefit of tourists, we cannot be expected to touch even on all the salient points which present themselves in a vegetation so beautiful and so varied. Suffice it to explain, in a few words, some of the prominent peculiarities or remarkable forms of Tasmanian Plants, as far as they may have interest to passing travellers. The lowlands' vegetation, as a rule, participates to such an extent in the physiognomy of that of Victoria and the southern parts of New South Wales, that in the mountain tracts and particularly in the alpine elevations must be mainly sought for attractive peculiarities of the Tasmanian Flora. However magnificent the fern-tree gullies, and however grand the forests of the evergreen beech (*Fagus Cunninghami*), these pictures of nature are analogous to those of Gippsland and other parts of the opposite coast, though the ravines with tree ferns and the dense shady forests are in Tasmania far more generally accessible, than in the S.E. part of the Australian continent. Hence invalids, unable to perfom difficult or distant excursions, will even in the lowlands of the island derive very great enjoyments on clear fern-lined brooks, which meander through depressed valleys in all directions, or find invigoration and delight even in the park-like Eucalyptus ridges, or amidst the meadow flowers, or heaths, or shore vegetation, which, although all but identical with that of the adjacent colonies, maintains, in the humid and equable climate of Tasmania, a freshness throughout the year not readily found elsewhere. Those in quest of more startling objects can easily gratify their wishes by penetrating no distance into the valleys, to measure the ancient denizens of the forests, which in their undisturbed growth through past centuries attained dimensions so colossal, as to rank amongst the most

gigantic of trees of the globe. To have run the measuring-tape along and around a sunken stem of a blue-gum tree or to have measured the angle of an Eucalyptus *amygdalina* from its shadow to its crown, will gain records for a tourist's diary, likely to be received by most people with scepticism.

The walks need not be extended far into the forest glens, to fall in with the Waratah peculiar to the island (*Telopea truncata*) or with the equally endemic *Aristotelia peduncularis* and *Anopterus glandulosus*, both among the grandest plants of Tasmania, and generally companions of the singular celery-pine (*Phyllocladus rhomboidalis*). In these forest valleys, on musk trees (*Asterargophyllus*), on sassafras (*Atherosperma moschatum*), or *Plagianthus sidoides*, may be searched for our most southern of all orchideous Epiphytes (*Sarcochilus Gunnii*), while the rocks may be found overgrown by a species of the epiphytal genus *Dendrobium* (*D. striatum*), which attains in a New Zealand species its most southern limit. Mosses, lichens and fungi abound in the moist recesses of the mountains, and many a hidden form of these plants awaits still the elucidation of a phytographer. But the researches of local residents, among whom R. Gunn, Esq., F.R.S., Dr. Milligan, F.L.S. and the Hon. W. Archer, F.L.S., were most prominent, have left scarcely an opportunity of adding actually novel forms to the known phanerogamic vegetation, the scientific investigations of these gentlemen having extended over about 30 years, while those of Mr. Gunn simultaneously embraced the forms of the animal kingdom of the island also. Nevertheless an observer, who may penetrate into new mountain recesses, or may follow the recent tracks of miners, would largely yet augment our knowledge of the localities, over which the rarer species are distributed, and thus even now any one of enlightened genius might yet stamp his name as a discoverer permanently on the vegetation of Tasmania.

Considering the comparatively inextensive area of this island, the vegetation, which with an ever verdant mantle envelops it, must be regarded as rich and extremely varied. About 90 orders of cotyledonary plants are represented, embracing, when reduced to exact limits, 950 species. Of these 80 are trees, the smallest of which attaining at least 30 feet in height; among the trees those of the eucalypts, numbering ten, are prevalent and often gregarious, three or four of them alpine. Of the whole of the cotyledonary plants, 130 are exclusively restricted to the island, and of these again approximately 80 are confined to the Highland regions. Moreover, the endemic genera are mostly alpine, namely: *Milligania*, *Campynema*, *Hewardia*, *Microcachrys*, *Diselma*, *Athrotaxis*, *Bellendena*, *Cenarrhenes*, *Prionotes*, *Pterygopappus*, *Tetracarpaea*; but *Agastachys*, *Acradenia* (Lady Franklin's tree), and *Anodopetalum* are jungle genera, the latter, known as the Horizontal Bush, extending to the forests of the lowlands, whereas *Richea*, *Diplarrhena*, *Drymophila*, *Juncella*,

Nablonium, *Orites* and *Anopterus* occur beyond Tasmania only in South-East Australia, and *Ourisia* only near us in New Zealand; but *Huanaca* and *Eucryphia* are also found in South America. The majority of the alpine plants belong to genera, which have representatives also in the lowlands; *Caltha* however and *Anemone*, as well as *Fostera* and *Donatia*, are exclusively alpine. A dwarf raspberry plant with a pleasant fruit (*Rubus Gunnii*) belongs to regions covered in the winter with snow. The most remarkable features on the snowy heights are two composite plants, *Pterygopappus Lawrenci* and *Abrotanella forsteroides*, on account of the large cushions formed by them; no plants of similar growth are to be found in the Australian Alps, but several in or near the glacier regions of New Zealand. The beautiful glacier lakes of Tasmania are denied to the Australian Alps.

Hobart is one of the very few maritime cities in the world, from which alpine elevations can be reached within a few hours' walk; and in our strictly Australian colonies it is the *only* city, which is built at the base of a snowy mountain, while streets of it are stretching to the very brink of the sea. Hence, from heights, snow-crested almost throughout the year, views—most glorious and expansive can be enjoyed, in which dashing waves of the ocean, charming features of the city and alpine surroundings in the foreground are concentrated all in the same pictures of the landscape. A few of the larger settlements of the also grandly picturesque island-country of New Zealand, near to us, share in the rare advantage of such physiographic combinations.

The rough paving of a narrow path over the "Plough-Field" boulders of the upper slopes of Mount Wellington, and simple provision for an artless stone-hut iron-roofed, at the most commanding elevation of that mountain, would greatly increase the ascents to the extensive plateau of the summit; thus tourists and picnic parties would alike be benefitted, while, by the plain shelter thus afforded to the searching naturalist as well as to the sketching artist, ready opportunities would be gained to camp out, as such comparative inexpensive measures would give shelter to whosoever may be overtaken by sudden boisterous changes of the weather in regions apt to be involved in passing clouds.

The pretty blue-striped Gentian has a most pleasing effect on the alpine meadows, and so the white Woodsorrel (*Oxalis Magellanica*) along the rivulets. Grandest among all these highland plants are however the two palm-like *Epacrideæ*, which pass under the strange name of cabbage-trees (*Richea pandanifolia* and *Dracophyllum Milligani*), both attaining a height of 30 feet, or the former sometimes double that height; thus they introduce a tropical aspect into a landscape, which for half the year is buried in snow. The regular collector of plants will be richly rewarded anywhere in Tasmania for his exertions alike

on hill and dale, in heaths and forests. *Epacrideæ* are numerous and always handsome, and so Everlastings (*Helichrysum*), the tall shrubby kinds of the latter (*Ozothamnus*) being particularly conspicuous; so also deserve notice the many different woody Asters, the various gay pea-flowering bushes of the podalyrious tribe, the balsamic Rutaceæ, the fly-catching Sundews, the various Proteaceæ, as very many of these plants are not to be found out of the island. The varied and often delicate ferns, which line the brooks or depend in graceful forms from the trunks of trees, though hardly offering endemic species, will form ample material for ladies' albums. Of fern-trees two species occur as widely distributed, namely, *Alsophila australis*, the more slender of the two, which occupies mostly the slopes of the ranges when such are springy and umbrageous,—and *Dicksonia antarctica*, which is more fond of the bottoms of the vallies, and has proved the most easily transhipped of all fern-trees of the globe and the most hardy also, so that any visitor of the island may transplant to a shady watered part of his garden most readily one of these noble and aged plants in remembrance of his voyage; indeed horticultural energy may still further develop this new branch of commercial enterprise. The Cyathea-Fern-tree is far more rare. Ponderous huge Todea Ferns with irregular square stems occur in deep mountain recesses, from whence they may be moved to wide distances, though weighing perhaps a ton and being a century old. As arborescent *Senecio Bedfordi* and *Senecio centropappus* are remarkable in an enormous cosmopolitan genus, while *Prostanthera lasiantha* attains, as far as known, alone among several thousand Labitæ to the height of a fair forest-tree. The Pepper-tree (*Drimys aromatica*) ascends from the forests to the Alps. *Fagus Gunnii*, a beech of the lake country, is the only indigenous tree, with deciduous foliage, of the Island. The dwarf alpine coniferæ, peculiar to Tasmania, are among the most interesting of the globe, Dacrydium (*Microcachrys*) tetragonum being the smallest pigmy among all known coniferous plants. The famed Huon Pine (*Dacrydium Franklini*) is restricted to the Island.

The shores are singularly rich in seaweeds; rather more than 300 kinds are enumerated through the glorious researches of the late Professor Harvey, in the large and beautifully illustrated work, which Sir Joseph Hooker's great talents and original researches have produced on the general Flora of Tasmania; and not only are these Algæ there far more numerous than in most shore parts of the globe, but they contain also many species, such as the rare Claudea, which for their vivid colors and delicate beauty are famed far and wide.

Mrs. Meredith's charming book on her "bush friends" of the flora of Tasmania will afford to amateurs instructions of the most pleasing kind, the elegant delineations being blended with very ingenious and poetical explanations; whereas the lamented

Rev. W. Spicer, though an invalid during his rather short stay in the island, compiled, a few years ago, his "Handbook" for the ready use of Excursionists, the dichotomous method being adopted for this meritorious little work.

For the completion of an universal work on Australian indigenous plants, it is desirable to obtain additional collections of plants in a pressed and dried state, particularly from districts far inland or recently settled. It is an important aim by these means to trace out the exact geographic limits of the many thousand species which constitute the original vegetation of Australia, in order also that all observations on their respective utilitarian value, whether for pastoral culture, medical or industrial purposes, may become recognised and applicable to the widest extent. Moreover, it is necessary to study still further the degrees of variability to which all plants are more or less subject, with a final view of circumscribing the exact characteristics of each species. It is to be impressed on those who may feel interested in the promotion of such researches, not to exclude from local collections any plants merely because they appear frequent or insignificant. The process of drying plants for permanent collections is simple and easy in the extreme; it needs hardly any explanation, beyond perhaps the remark, that the parcels of paper containing any recently gathered plants, after a few hours' pressure, should be divided into thin sets and be spread out on a dry or warm place, to facilitate and to speed the exsiccation, and to lessen also the requirements of shifting plants from paper which became moist into dry paper. Small plants should be gathered with their roots, and all not merely in flower but in fruit also, as indeed from the latter generally the main characteristics are derived. Water weeds, rushes, sedges, mosses, lichens, fungi (and on the sea coast also Algæ), even if ever so small, should not be passed in collecting. Transits are best effected early after the preparation of the specimens, in small parcels of closely packed samples, by successive mails. Whoever wishes to become scientifically acquainted with the native plants of his vicinity, or of localities otherwise accessible to him, can obtain the specific names from the writer of these remarks by sending to him pressed specimens, a duplicate set being retained, in which the specimens are numbered correspondingly to those of the transmitted set. An intimate knowledge of the indigenous vegetation, while it largely indicates climatic and geologic circumstances, tends also to afford an insight not only into the natural vegetative resources of any tract of a country, but also into much of the available cultural capabilities of the respective localities. Researches of these kinds become furthermore the sources of educational works, and unfold, to well-trained and intelligent minds, pure recreative and healthful pleasures, inexpensively everywhere within reach.

II. Review.

REPORT ON THE FOREST ADMINISTRATION IN CAPE COLONY FOR 1883.

We have received a copy of this report from Mr. Hutchins, who is Conservator of Forests in King William's Town, and as the introduction by the Superintendent of Woods and Forests, who we believe still to be the Comte de Vasselot, although his name does not appear in the report, explains clearly what are the main objects held in view for forest conservancy at the Cape, we publish this introduction as it stands.

It is followed by a number of appendices, including a summary of instructions given to Forest officials by the Superintendent, which we also give unabridged, as they are of general interest. The remaining appendices consist of the report of the Superintendent of Plantations, Mr. Storr Lister, in which there is not much to note, except a mistake about the object of the sissú plantations in the Punjab, which are really made for a supply of fuel, and not as Mr. Lister states, for railway sleepers. If Mr. Lister had consulted Gamble's Indian Timbers he would have seen that, for furniture, building, and general use, the sissú is one of the best of Indian timbers, but that it does not figure amongst the woods used for railway sleepers.

Mr. Harrison, who is Conservator of Forests, Knysna, has written a short report comprising only one page of foolscap. Mr. Hutchins' report is much longer. He has introduced a good system by which no trees situated near watercourses, roads, and on the edge of the forests, will any longer be felled by license holders. He also proposes experimental girdling of trees before felling, and remarks that girdled timber is lighter and less putrescible, but at the same time, is harder to fell and saw than green timber.

Girdling sál trees in India has been found to introduce borers, from which sál timber, barked after being felled when green, is exempt, so that we shall be very glad to hear the results of the experimental girdlings, at the Cape Forests, from a future report. The following remarks about cattle grazing are very appropriate.

"*Grazing.*—As soon as a forest is demarcated, the question arises within what limits, if at all, should grazing be permitted. Only in a forest in which reproduction is left to take care of itself, can grazing be permitted without restriction. But I have known cases in which

the absolute exclusion of cattle has been carried too far, in which the cattle did less harm to forest reproduction than the grass which succeeded the cattle, not to mention the increased danger from fire, the increased cost of fire protection, and the loss in money value of the grazing."

Sneezewood (*Pteroxylon utile*) appears to be the most valuable tree at the Cape Colony, and from the inspection of some sneezewood piles taken from the Port Elizabeth Breakwater, which have been 20 years partly in and partly out of water, and in which, although the sapwood is riddled by marine borers, the heartwood is as sound as on the day when it was first put down, Mr. Hutchins concludes that this timber is imperishable.

Regarding the scarcity of sneezewood, Mr. Hutchins states that teak, costing 7 shillings a cubic foot, is now being used *above water*, and American greenheart, costing 10 shillings a cubic foot, *under water*, because large sound sneezewood logs are not obtainable.

Sneezewood resembles greenheart in the pungent bitter taste of its heartwood, and is said to be indestructible when used for railway sleepers. Mr. Hutchins has sent sneezewood seed to India, in the hopes that, it may supply a want felt in the Nilgiris in the presence of the very fast growing but rather perishable Australian Eucalypts and Acacias which have been introduced.

He proposes with a view to its protection to raise the price from 7*d.* to 1*s.* per cubic foot.

Forest demarcation is being steadily pushed on, and it is proposed to place each demarcated State forest under a European forester, who will be housed and paid about £5 or £6 per mensem, and will have under his orders a small staff of mounted Kaffir forest guards on £3 per mensem.

Mr. Hutchins' remarks on exotic timbers are very interesting, and are here given in full : —

"*Exotic Timbers.*—Few subjects, to a Forester, could afford a wider field for speculation and experiment, than the introduction of the more valuable species of large forest floras to the restricted forest vegetation of South Africa. Extraordinary results in the way of production of wood per acre have been produced in the diminutive temperate region of South India, by the introduction of trees from Australia. In Cape Colony so many introduced trees are planted successfully, in places where trees do not grow naturally, that it does not appear to be taking a sanguine view, to anticipate that the majority of the introduced trees will flourish very much better in those favoured parts of the Colony where natural forests exist already. It seems to be the general opinion of those who have planted indigenous and introduced trees, that the latter are easier to plant, and grow more rapidly than the former. In the forest nurseries, which form an essential part of the plans for the restoration and improvement of the forests, it is proposed to make a thorough trial of the many valuable exotic timbers which are natives of warm temperate climates.

Seeds are expected of Eucalypts, including Yarrah, from Australia, of the Deodar and other Himalayan trees from Northern India, of Oaks, especially *Quercus Cerris*, and a large variety of other trees from England. These will be tried at elevations likely to suit them, from 5,000 feet downwards to the sub-tropical climate of the Eastern coast. The bulk of the nurseries will, of course, be occupied by indigenous and naturalized trees—the common Oak, Pines, and Gums, together with Sneezewood, and such coppicing species, as may be found best suited to the fuel copses. The indigenous species are hardly likely to succeed outside the limits of the natural forest; they are mostly of slow growth, and, compared to Conifers and Eucalypts, are wanting in height. Happily these objections do not exist in the case of the several hardy exotics long naturalized in Cape Colony. The naturalized Pines (*Pinus Pinea* and *Pinus Pinaster*), it is certain, will grow, reproduce themselves, and spread naturally on the bare hill-side. The naturalized Oak, *Quercus pedunculata*, will grow, and no doubt reproduce itself from seed, as soon as an open forest soil is formed. It is anticipated, also, that this species will prove of value in the formation of permanent fire-lines. The natural reproduction of the naturalized Gums is less certain than that of the naturalized Oak and Pines. Near Cape Town the Blue-gum appears to produce self-sown seedlings, but not abundantly, like the Oak and Pines. At Grahamstown, and farther East, self-sown seedlings of Blue-gum are less common; but everywhere it appears useless to look for self-sown seedlings, except under oldish trees, which are not common in the East of the Colony. At Kabousie neck (3,000 feet), there are self-sown seedlings of Blue gum, in a position not very favourable to their production, but the trees that have produced them are old. Whatever may prove to be the seedling reproduction of Eucalypts in the Amatolas, their coppice reproduction is certain (on the condition that cattle are excluded), and as wood-producing trees, their value is far too great to be neglected. In more forcing climates, such as that of a moist temperate region within the tropics, the growth of Eucalypts, especially the Blue Gum, is faster than that of any trees hitherto observed. In parts of Natal the Blue Gum has been reported to have yielded a mean yearly production of wood at the rate of ten tons per acre. On the Nilgiri Mountain, in South India, acre-increments up to as much as twelve tons of dry wood have been obtained. Figures such as these are quite exceptional, and, except with irrigated land, could hardly be expected in Cape Colony.

"In very dry and exposed situations, probably Pines and other Conifers will prove the most useful for reforesting. There appears to be no situation so wind swept and exposed, that some of the Australian wattles will not grow there. As has been mentioned, if the indigenous evergreen forest is carefully managed, it will require no special measures or expenditure for fire-protection, and I anticipate that little difficulty will be experienced in protecting the intervening strips and tongues of grass land as they are gradually afforested. These areas are more or less surrounded by evergreen forest, and are thus protected naturally, to a great extent, from fire. Strips of grass land running up into the forest can be fire-protected (as long as this is necessary) by a fire-path close to the demarcation line, and a few cross lines running parallel to the first line."

The scale chosen for the maps which are being prepared for the management schemes (working plans) of the forests is 8 inches to the mile.

Mr. Hutchins refers to Mr. MacGregor's criticism in his recent work on Forest Organization, that the scale chosen for forest maps in India is generally too small, and recommending a scale of 8 inches to the mile, but we hold the opinion that a scale of 4 inches to the mile is in general quite sufficient in India, and that public funds would be wasted were a larger scale to be used, though in certain exceptional cases this may be necessary. We give below the Comte de Vasselot's introduction to the Report and his Summary of Instructions :—

"The work of the Forest Department, considered in its entirety, comprises many branches. Its aims should be : —

"I. To preserve forests in which timber still exists, from exhaustion, by reckless and indiscriminate cutting, and by being thrown into disorder at anybody's pleasure. (Urgent at Knysna).

"II. To prevent exhausted forests from disappearing altogether, by giving them protection against encroachments which invariably follow fires and excessive cutting; by preventing cattle from destroying young plants as they appear; by repairing and restoring those parts of the forests which have been in any way injured; by re-planting tongues of land, stretching dangerously into a forest, which can be preserved only by including both barren and wooded land in one reserve perimeter for re-planting as quickly as possible. (Urgent in Eastern divisions).

"III. To lay out forests where they would be of benefit to the Colony. (Cape Flats and Table Mountain, for instance).

"IV. To shew Colonial forest products to their best advantage by preparing them properly (sleepers), and by shewing specimens at International Exhibitions for the information of the markets of the world (Edinburgh for example).

I. Management and Preservation.

"*Conservation of Knysna.*—Operations under the first head, on account of their urgency, are being specially directed to the Forest Conservation of the Knysna (Divisions of Knysna, George, and Humansdorp), where are yet found magnificent remains of the primeval forests of the Colony.

"The forests of this region comprise about 50,000 morgen of wooded land, specially adapted for the supply of timber.

"*Exhausted Forests.*—The forests of George, and in the Tzitzikama country, scattered to the east of the Storm River, and those in the Knysna Division in proximity to the road from Knysna to Plettenberg Bay; in a word, all those forests which have been easily accessible for any length of time, are completely exhausted; not because a larger quantity of useful timber has been drawn from them than they were able to produce, but because the random and careless manner of working has destroyed and wasted twenty seven times* as much

* Twenty-seven parts wasted for one part used is not a figure of speech! It is a minimum which can be easily proved mathematically. Thus, it appears from statistics of 1878 that a "hectare" of "futaie" (timber trees) in the

wood as has been used, and the growth of young trees handicapped beyond measure. These plants, after being opened out by the felling of neighbouring trees, only required rest to increase and grow, and they would in their turn have supplied mature timber.

"Ten years more of such management would have sufficed to strip the Colony of every forest it possesses. There would then be little indeed to be proud of in our Colonial woods.

"*Regulations for arresting destruction.*—The Regulations of 1883 have, however, put a stop to this state of affairs. They enjoin that only such wood shall be cut in each forest, as is fit for use, and over limited areas, arranged in succession, so that when the last section of a block has been worked, the first will again be stocked with matured trees, and so on.

"*Areas prescribed for cutting.*—In the second place they prescribe that trees shall be marked in advance for cutting in each open section without prejudice to the future of the forest.

"These arrangements require much preliminary work. It was begun in March, 1883, and by the 31st of December in the same year twelve blocks had been laid out, eleven sections defined, and trees marked for felling in the sections, numbering altogether 17,750, and measuring 324,953 cubic feet of good serviceable wood, and in addition numbers of poles and spars.

"Before putting these regulations into practice, fears were expressed whether the prescribed areas would be able to supply sufficient timber to meet the demand. On this point, however, all doubts have now been removed, for at the present moment there is more material available in those parts already prepared for felling than the average consumption of the six preceding years, which, from 1877 to 1882, was at the rate of only 92,000 cubic feet per annum.

"There was indeed some ground for fear that without a more numerous staff, and more experienced in work of this nature, it would be impossible to arrange forests into blocks and sections, and to have trees marked in advance ready for felling.

"To judge of the importance of this work it is only necessary to refer to tables of instructions in the Appendix, Nos. 2, 3, 4 and 5.

"*Combination of 'Coupes.'*—To properly manage a forest (aménager une forêt) its working should be regulated for the best interests of

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French Government Forests produced three cubic "mètres" a year, *i.e.*, about one hundred (100) cubic feet per morgen, and according to investigations made in France and Germany the annual production of a "hectare" in Europe may reach 14 cubic "mètres," or 600 cubic feet yearly In the Colony the growth of trees is certainly quicker than in Europe, judging by the width of the rings of growth. Let us consider, however, that only the mean production, according to the statistics of 1878, is possible here, *viz.*, 100 cubic feet per morgen. The area over which the trees in question have been cut being 25,000 morgen in extent, would have certainly produced two-and-a-half million cubic feet if it had been methodically worked, and two-and-a-half million cubic feet could have been taken out every year *for ever*, with the certainty of always finding the same quantity of wood available in these forests. Instead of which, they have been cut down right and left without any rule or method, and have supplied a yearly average of only 92,000 cubic feet according to the statistics of the Knysna Conservation, and the result is that these portions of our forests are completely exhausted. There is then only too much truth in the statement that we have wasted twenty-seven times more wood than we have used.

proprietors and consumers. That is, the 'coupes' should be so combined, that the largest yearly average may be drawn from the forest *for ever*, and at the same time improve its own condition.

"This is a long and difficult operation. The systematic arrangement of a single block, at an average, takes a scientific and experienced officer six months, with the assistance of several subordinates. But when the result is to obtain double the production, and often more than double, say, for example, 200 cubic feet per morgen per annum, instead of 100 feet, and that maintained at a constant figure, it certainly cannot be said that time and money are being wasted.

"Here it was impossible to undertake a work so complete without first arresting the wanton destruction going on. In order to better appreciate the value of the task accomplished, let us make a comparison. The timber cuttings had spread throughout the open forests, like the waves of a torrent let loose over the country. My fellow labourers, working with energy and zeal, as in the presence of a plague, hurriedly formed blocks and marked trees for cutting in sections equal to one-twentieth of each block, in which to rigidly confine exploitations, as one would have dug deep channels wherein to receive and gather together the vast sheets of water inundating the country. Now that nineteen-twentieths of the forests are no longer flooded by gangs of destroying woodcutters, attention can be directed to the best schemes for increasing their productiveness.

"*Quantity of wood increased by new system.*—Following what has been remarked before, we may safely conclude that the result of this first branch of our labours will be that each morgen of forest land will supply for general consumption more than twenty times as much timber as formerly.

"*Similar work to be done elsewhere in the Colony.*—There is indeed much work of this description to be done throughout the Colony, wherever there are any forests at all, notably at Swellendam (see Appendix No. 14) and in Divisions of Griqualand West (Appendix No. 26), where the destruction of forests is going on at a great pace.

II. DEMARCATION AND RESTORATION.

"Operations under the second head have been mainly directed to the Eastern Divisions of the Colony. On this subject details and explanations will be found in the Annual Report of the Conservator of King William's Town (Appendix No 20); in the reports of the same officer relative to the demarcation of Stockenström (Appendix No. 24); to the demarcation of the division of King William's Town (No. 23); and on the condition of the forests in the Division of East London (Appendix No. 25). Reports of the Rangers of Stockenström and East London are also annexed (Appendices No. 21 and No. 22).

III. AFFORESTING AND PLANTATIONS.

"*Operations in the Cape Division* Operations under the third head are being actively carried on in the Cape Division by Mr. Lister. For his Annual Report see Appendix No. 13.

"It is a matter of the utmost importance that Table Mountain should be re-forested (see Appendix No. 7 and map). On this subject the following remarks may not be inappropriate.

"The absence of rain in the summer months is a general cause of

complaint in the Western portions of the Colony. The atmosphere is, however, charged with moisture, and the winds known as 'Black South-Easters' are laden with clouds, but at the present time the bare surface of the mountain, baked by the scorching sun, offers no attraction to them. Their vapour is rarefied to a very high degree, and they pass away leaving no trace behind. Now if the mountain were clothed with forests, there is every reason to believe that the clouds, attracted by a canopy of foliage, infinitely cooler than the burning rocks, would frequently be condensed into copious rains. I am assured that such was the case within the last twenty years in the neighbourhood of Cape Town. The mountain was then covered with trees and bushes, and the 'Black South Easters' of summer almost always brought abundant rains, to the immense benefit of the surrounding country.

"However that may be, the fact remains that the drying up of the mountain springs follows the disappearance of the bushes. Mr. Gamble, the Hydraulic Engineer, has not hesitated to give the alarm (see Appendix No. 7—1), and it will not be the least of his services to have drawn attention to the measures necessary for preventing water becoming scarcer and scarcer every summer in the neighbourhood of Cape Town, even after exceptionally wet winters.

"*Effect of fires on vegetation.*—Fires have been a most fruitful source of destruction to forests. Places where woods have been burnt reclothe themselves with a particular kind of vegetation—keur bushes and brushwood. Their rapidity of growth denotes a rich layer of soil underneath. When these places are not too steep or too thickly covered by rocks or stones, they excite the envy of those who have properties adjoining.

"*Fertility of land after fires explained.*—That the vegetative vigour of such land is not due to any inherent natural qualities may be easily demonstrated.

"*1st.* By an examination of the sub-soil on which it rests.

"*2nd.* By remarking that the fertility of the soil gradually diminishes as each successive fire consumes fresh vegetation.

"*3rd.* By observing that all places which were formerly forest lands, but have long since been replaced by pasturage or cultivation, thus obliterating all traces of forests, have identically the same kind of soil as those places which never were forest land within the memory of man.

"The fertility of such land is entirely due to the presence of vegetable matter accumulated during the period they were clothed with trees, and can therefore be but of a temporary character. It took centuries to create, but a few years suffice to destroy it.

"The owners of such properties will consider their fertility and productiveness of the present moment only; it is land which will grow excellent crops without any manure! and they congratulate themselves, thinking it will be always so.

"*Temporary Concession of Burnt Lands proposed.*—This would appear to be an instance in which the foresight of Government should be united with the eager but ill-directed zeal of proprietors.

"The Forest Department should have authority to make concessions of small patches of burnt Government lands for a period of four years. Conditions of tenure should be drawn up, which would, after that

period, make re-foresting very easy, and at no expense to the public funds.

"By this plan neighbouring proprietors could work such land, and profit by its yield during the years it would produce the best crops, and return it to the Forest Department enclosed, and with a good stock of young forest trees ready for planting out, before the soil is quite exhausted.

"The Forest Department should also receive a portion of the value of the fourth year's crop, which would put it in funds for re-foresting.

"Conditions of concession and details of the plan proposed to effect this object will be found in Appendix No. 6.

"The oak would grow in most of these places, and if forests were surrounded with plantations of this kind (oak, wattle, &c.) they would always have a sure protection from fire.

"*Beaufort West Afforesting.*—It was intended to commence afforesting at Beaufort West, a work which will some day have a powerful effect on the climate of this country, and on the influence of rivers which take their rise in the mountains of that region. For details of the objects in view see Appendix No. 8 and map.

"*Drift Sands at East London.*—In the Division of East London, the drift sands are encroaching to an alarming extent. Since September last, information has been gathered regarding the direction and force of the prevailing winds, see Appendix No. 9.

"Schemes are now under consideration for arresting and fixing them by means of vegetation.

"I have worked successfully for twenty years in protecting the mouths of the rivers Seudre and Gironde from encroachments of a similar nature, but infinitely more considerable, and have no doubt as to the success of the work about to be undertaken.

IV. Colonial Wood to its best Advantage.

"The particular qualities of Colonial wood have been the object of very careful examination.

"*Creosoting Colonial Wood.*—Experimental trials of creosoting have been made in England, on behalf of Government, with highly satisfactory results.

"On this side precautions have been adopted, and causes of deterioration avoided, in order that wood may be properly seasoned. Finally, the cost has been estimated of subjecting it to treatment by a solution of sulphate of copper.

"The first cause of deterioration is the action of very powerful heat on newly cut trees. The more moisture there is in the tree, and the higher and drier the temperature, the more rapid is the drying-out, the contraction is irregular, and consequently deep splits occur.

"*Season for Cutting.*—Hence we should be led to conclude that cutting when the sap is down in winter, and keeping the wood out of the sun, are essential conditions for its preservation.

"(I reserve my opinion, however, on the vexed question as to the influence of the sap if it is dried out during certain solar seasons. If, however, any discussion should be raised, I think that the question of season should be regulated by the period of repose).

"That would mean it is better to cut down a tree in winter, even though full of sap, than in summer when it is at rest, leaving it,

however, quite intact with bark and branches on. Last spring the hard pear-tree and the vlei were pointed out to me as being in repose, because their fruit was ripe. To look at them was sufficient to prove that such was not the case. Nevertheless it is a fact that all the sleepers manufactured in order to assist distressed woodcutters, were taken from wood full of sap. Otherwise, I have met with no such difference of opinion.

"On the other hand, the more liquid in the tissues the greater is the facility for fermentation, and the change is shown by the appearance of fungus, mouldiness, wet and dry rot, and finally by the formation of ulmic acid.

"Therefore logs should not be allowed to rest upon the ground, but should be placed upon blocks, and separated by laths, to allow evaporation to go on freely.

"Precautions have been drawn up to be observed in the preparation of wood for the Railway Department. See Appendix No. 12.

"*Sleepers for the Railway Department.*—When it was required to prepare sleepers from wood in season, not a single species could be found in that condition at the time the order was received to make the experiment.

"Several sleepers, however, were made from wood out of season, in order to test it under those conditions. See Appendix No. 10. As the wood was inclined to split, the Conservator thought it well to have it removed to the reservoir at the Gouna saw-mills, which Government had lately acquired.

"The person there in charge of the machinery, thinking the presence of tannic acid in the water would injure the boilers, had them taken out of the reservoir, and consequently they were spoiled. The conservator should certainly have asked permission to immerse the wood, but if one officer had charge of both machinery and wood, he might perhaps have reflected that the machinery could not be used until winter, and that the rain water would carry away the tannic acid before the boilers would be heated, and so a loss to Government would have been avoided.

"*Xylophagous Insects.*—Insects are frequently a source of great destruction. I am indebted to Mr. Peringuey, whose knowledge on this subject is surpassed by no one of my acquaintance in the Colony, for a treatise on xylophagous insects, a question of too much importance to be omitted from this report. (See Appendix No. 26.) Wood might perhaps be preserved from the ravages of insects, as from rot, by the use of antiseptics.

"*Cost of Injecting Sulphate of Copper.*—The cost of the preparation of wood by a solution of sulphate of copper, is detailed in Appendix No. 11.

"The timber yards at Gouna, if placed under the control of the Forest Department, could easily be adapted for carrying on such operations.

"*Gouna Saw-Mills.*—Much labour could be economised by using the steam engines already erected; and, at less expense there than anywhere else, cylinders could be utilised for the preparation of wood in closed vessels.

"There would then be a useful and economical connection between the exploitation (cutting, sawing, &c.), the preparation, and the

manufacture of wood into sleepers, which is essential to the success of the venture. If, on the contrary, the whole work were not under the supervision of one officer, there would necessarily be a continual divergence of views, which would begin with difficulties, and inevitably end in the sacrifice of one of the two interests, to the great detriment of the Colony.

"*Appointment of Officer.*—It would therefore be necessary to appoint a competent officer for the Forest Department, who should receive salary and allowances of £550 per annum. He would take charge of exploitation, &c., at the Gouna, the saw-mills, the preparation by sulphate of copper, and would have control of the technical part of demarcations in that region.

"*Measures taken for Seasoning Wood for Railway Department.*—It is very desirable that the Colonial wood requisitioned for by the Railway Department should be supplied with all its good qualities fully developed.

"Measures taken with this end in view are explained in Appendix No. 12 (1), and precautions to ensure a satisfactory result are detailed in Appendix No. 12 (2). If, as is confidently expected, this experiment prove successful, many persons will be able to judge for themselves of the good qualities of the wood, and Government itself will be an official witness.

"*Edinburgh Exhibition.*—An International Forestry Exhibition will shortly be opened at Edinburgh. Without losing sight of technical matters interesting only to those concerned in the amelioration of woods and forests, this opportunity should be seized of making known to the world the great value and beauty of our Colonial woods.

"We should profit by pointing out the quantity annually at our disposal, of those species at all events, usually in demand.

"A description of specimens to be exhibited, and a short account of each species, will be found in a preliminary catalogue; Appendix No. 29.

"*Timber Trade.*—The general depression of trade has told heavily upon our internal commerce, and importations of timber, as shown in Tables annexed, No. 27. But, thanks to the action taken by Government in employing colonial wood for public works, it is sincerely hoped it will be otherwise in the future.

"*General Results.*—From these statements some idea may be formed of what has been accomplished this year. They will, at any rate, serve as a rough sketch to show those interested in the question of forestry, the great extent of the work to be done for the well-being of the Colony in this respect.

"All these improvements and alterations can be successfully carried out, but it is essential that Parliament should give the matter its careful attention, and make provision for the Honourable the Commissioner of Crown Lands and Public Works to carry out the resolution so wisely taken on the 26th June, 1883, viz.:—

"'The House of Assembly begs to inform the Honourable the Legislative Council that it has concurred in the following resolution passed by the Legislative Council:—'That this House, fully alive to the importance of having a proper Forestry Department in our Civil Service, desires to urge on the Government the various recommendations of the Superintendent of Woods and Forests (G. 1—'83) lately

laid on the table of this House; especially the suggestion therein submitted of sending young colonists to Nancy to be instructed in forestry for future employment in the service of this Colony, on the understanding that the proposals suggested in the said resolution will involve no expenditure of public funds, for such expenditure can, according to law and usage, only have its origin in, and be first recommended by, the House or Assembly.'"

"Speaking now from a practical and painstaking experience of three years, I can safely say that by no other means than those indicated, can the Colony reap a real and lasting benefit from its woods and forests.

PART I.—GENERAL OBSERVATIONS.

"*A.—Conditions of a Systematic Treatment.*—The new regulations begin with some remarks from a technical point of view, on the general principles of forest treatment:—

"'To fell the quantity of timber equal in amount to that which the forest can yield annually in perpetuity, so that each year the quantity may be replaced.

"'To assure the reproduction, as quickly as possible, of the best species on the parts cleared.'

"There is here enunciated the economic proposition that a Crown forest, in its land and in its wood, constitutes a capital belonging to the community at large—a community which it is essential to consider as being imperishable. This capital should be husbanded, improved, and increased in proportion to its utility, and above all, to the influence which this class of property may exercise on the climate and wealth of a country. This capital is composed of the value of the soil, plus the value of the wood covering it. Trees increase in bulk and form; thus each year a certain number of cubic feet of wood is added. If on any one plot of ground there are too many trees, the growth will be proportionately less. If there are vacant places in the plot the sum of the growths will not be as large as if the whole surface were completely covered by trees. And, lastly, if the plot is wooded with over-mature trees the sum of the growth will be smaller than where the plot is furnished with trees in full vigour of growth. Thus, for a given surface there is a certain quantity and arrangement of trees that will give the greatest possible yield; and the capital, in its two-fold sense of the land and the wood which it carries, should be brought to that point at which the greatest possible yield can be realised; if, from a forest producing each year a certain number of cubic feet of wood, no more is removed per year than a quantity equal to that which has been formed, the capital remains intact. Exactly as on a farm capable, for instance, of carrying 1,000 head of cattle, and on which 100 head of cattle are born per year, if not more than 100 head are used during the course of the year, the capital may be said to remain intact. If, then, we are to avoid trenching on the capital, the annual production of wood, like the harvest from cultivated ground, must not exceed the yield of the ground. Only the value of the yield can be legitimately credited to the general revenue and expenditure of each year. Thus—

"*1st.* A forest should be worked so that in any one locality a young, and better growth, may succeed the old forest which has been cut down.

"2nd. The quantity of wood cut each year ought to be such, that the forest may be maintained at the maximum of production; and, this point reached, no more wood should be cut than is annually produced.

"3rd. All trees should be utilised and turned to profit except those required for the conservation and improvement of the forest.

"(1). *Reproduction of the Forest.*—The following conditions require to be fulfilled in the reproduction of a block of mature high forest:—

"1st. A complete sowing (*ensemencement*) of the ground.

"2nd. Protection of the soil from the action of the sun.

"3rd. Shelter to the young plants for the first few years of their existence.

"4th. Atmospheric influence allowed to act gradually on the young plants according to the individual temperament of the species.

"These four conditions are ordinarily realised in practice by means of three successive 'coupes,' or cuttings, following one another over the same ground at short intervals of time.

"*Seedling Coupe (Coupe d'ensemencement).*—The principle of this coupe is, that while enough trees are cut to admit the light required for germination of seeds, and the early development of seedlings, sufficient trees are left to furnish a good supply of seeds, and to shelter the young seedlings.

"*Secondary Coupe.*—As the young re-growth acquires more strength, more light is necessary for its growth. For this purpose a portion of the trees left in the first, or seedling, coupe, are felled; by preference those trees are taken which dominate the most vigorous re-growth of young plants, care being taken, nevertheless, to still leave a certain number of trees for the partial shade so beneficial to young plants.

"*Final Coupe.*—When at last it is judged that the young re-growth of seedlings and saplings is strong enough to stand alone in the final coupe, the remainder of the old trees are cut down. Henceforward, with full light and space the young trees grow rapidly. In this manner each compartment of the forest is regenerated successively, and when the last tree of the last compartment has been cut, the rotation is finished; the coupes then begin again with the trees which have had full time to mature in the compartments where the first reproduction cuttings were made.

"Thus each compartment is wooded with trees of the same age and growth, and the forest presents a series of groups of trees of different ages, the groups being graduated, and maturing one after the other in succession. In this state a forest is called 'regular,' and such is the mechanism by which, apart from any extreme conditions of vegetation, a regular young forest is made to replace mature old trees.

"In the forests of the Colony, on account of the power of its climate in light and heat, the coupes may be simplified. In fact I have noticed that almost everywhere the forests show a good natural reproduction of plants of the best species. In all the forests that I have visited, it will be unnecessary to make separate seedling coupes; the seedling and the secondary coupe may be thrown together. And further, if, when this combined coupe is being made, care is taken to mark for felling only thoroughly mature or overmature trees, and to reserve

for shelter, young trees in full growth, selecting those developed from seedlings, and avoiding those developed from coppice shoots, the trees reserved will be of a class that can remain usefully on the ground up to the time of a subsidiary improvement cutting, made with the double object of thinning the young growth, and to clear off the ground all trees which have by that time become mature amongst the reserved trees.

"Those of the old reserved trees which remain after the improvement coupe, will be left finally for the end of the rotation, and will naturally furnish very fine wood, they being all picked trees left exceptionally long on the ground.

"(2). *Quantity of wood to be cut Yearly.*—In order to fix the quantity of wood which may be cut each year in a forest, in order to have the same quantity always available, this quantity being the greatest annual yield, or *capability* (Possibilité) of the forest, account must be taken of:—

"1st. The area of the forest.

"2nd. The material on the ground.

"3rd. The age at which the trees are workable (exploitable).

"Thus, supposing trees of the more valuable species are mature at 80 years of age, that the soil is uniform and wooded with a succession of groups of trees reaching 80 years one after the other, if each year one-eightieth of the area of the forest is cut over, the cuttings of course being done regularly according to the gradation of ages, then the quantity of wood to be cut each year will remain the same for ever; in other words, the fellings will not exceed the capability of the forest.

"The above is a simple case, but in every management scheme the three essential points are those enumerated above, *viz.*, the area of the forest, the condition of the trees now on the ground, and the age at which they mature.

"(3). *Sale of Forest Produce.*—Payment for wood, and all forest produce, is made to the exact value of the licences delivered, or on the sale price of the exploitable material on a plot of forest, in cases where sales are possible (Government Notice No. 406, 1883, § 4), according to the conditions of sale here appended. Illicit fellings in a forest are deplorable; directly, in the lost value of the wood stolen, indirectly, in the effect on the sale of wood felled in a legitimate manner. Wood from illicit fellings can be sold at a price below that which the legitimate dealer, who has had to pay for his licence, can afford to ask, and who thus loses an outlet for his industry. In forests it is essential that police measures be rigidly enforced, and this cannot, of course, be done without an adequate staff

"*B.—Old Method of Working and its consequences.*—When a forest was opened, the wood-cutters searched it through, picking out the best trees for felling. The felling and taking out of these trees inevitably caused damage to the surrounding forest.

"Scattered and repeated workings in different parts of the forest are especially disastrous. When timber has been felled in any locality, young trees which have not been too much damaged, or too closely covered up with refuse and waste wood, begin to straighten themselves, to recover from their injuries, and to grow into useful trees. But as soon as the best of the mature trees in a forest had all been

removed, the wood-cutters went over the ground again looking for trees which at first were thought to be not worth cutting. Then the same process of damaging the young growth and surrounding forest was repeated. Each time, just as the young growth was recovering from the effects of previous workings, another tree felled in the neighbourhood partially destroyed the young wood again. In the end, when the forest was nearly worked out, it was closed, leaving the soil strewn with the remains of the old worked trees, and a young growth often too much damaged to be capable of thorough recovery; above this are old mis-shapen trees which, with their long horizontal branches, take up more space than would several well-formed younger trees.

"It is better, of course, to give the young re-growth this small chance of recovery, than by repeated scattered fellings to destroy the young growths altogether. The complete closing of the forest stays its utter ruin, but the wood-cutters are thereby deprived of work, and the locality of its supply of wood.

"*C.—Problem to be solved.*—The problem that has to be solved is this:—

"*1st.* To conserve and improve the forests, *i.e.*, to insure both their natural reproduction, and, by having a gradation of ages, a sustained and constant supply.

"*2nd.* To obtain this result by a method which will allow of the utilization of over-mature trees scattered throughout an irregular forest.

"*3rd.* By a steady supply of wood, to provide for the wants of the community at large, as regards wood and a forest revenue, and for the wants of the wood-cutters in the matter of regular work. The result of my inquiries on the age at which our most valuable forest species reach maturity, leads me to the conclusion, that for the present, and subject to correction as our knowledge extends, we may assume that the age of maturity of the more valuable species lies between 60 and 80 years for certain 'essences,' and 120 and 150 years for others. This period of maturity passed, it is probable that over-mature trees may still remain uncut for a considerable period without showing any pronounced signs of decay, or experiencing any notable decline in value, comparing the yearly growth in wood to the yearly interest on the capital value of the trees. I am of opinion that, having regard to the forest condition prevailing at George, Knysna, and Tzitzikama, the principal cuttings can be managed so as to leave on the ground more or less regular masses of young trees, the mean age of which will be between 20 and 40 years of age, and 80 and 100 for others. And these trees will require nothing but complete rest to reach their term of maturity.

"In Europe two years are allowed to contractors, or purchasers, to complete the working out of a coupe; these two years should not be exceeded on account of the danger done to the re growth as long as the young trees in the coupe are at the mercy of the workmen and their cattle. The two years cannot be shortened without inconvenience to the wood-cutters, more especially perhaps in this Colony, where the different species of timber are held to be in season for a few months only.

"To divide a forest into blocks of between 400 and 1,000 morgen,

natural boundaries, such as rivers, valleys, ridges, &c., can generally be utilised; where these are not available block lines are opened.

"Sub-dividing each block of forest (or series) into 20 sections or compartments, each of these sections being worked during two years, felling will proceed by bi-annual sections regularly through the forest, so that the mass of trees on any one section will have 40 years rest, or in other words, be ready to cut at the end of the rotation of 40 years. The division of the forest into blocks, and the sub-division of the blocks into 20 bi-annual cuttings (Art. 1 of the new Regulations), in which the number of young trees left on the ground is equal to the number of mature trees cut, provides a solution of the three closely connected questions enunciated above, since the conservation, the regulation, and the working of the forest within its capability, are all provided for. The object of improvement cuttings is to finish the work which the principal coupe (executed as has been explained separately) has done more or less completely. These improvement cuttings will consist of thinnings, giving the young trees greater space to grow in, and bringing under the axe a certain number of mature trees which could not, without some loss, be left standing until their turn arrived to be cut in the principal coupe at the end of the rotation. Thus the forest will be improved, and at the same time conserved and made regular.

"In the second place, account has to be taken of the wants of those who use wood, and of those to whom it affords work and daily bread. From this point of view the forest blocks (or series) must be sufficiently small and numerous that there may be always a section (or compartment) open, and being worked, near localities where wood-cutters have settled.

"The number of sections being calculated so that the re-growth in the first section cut, will have grown into mature trees by the time that the working of the last section has been finished, it will never at any time be necessary to close the whole forest. In any section which it is proposed to open, there are always trees which it is desirable to cut in order to allow the re-growth to develop, and others which it is desirable to leave standing for seed and shelter. It is the duty of the forest officials to select and mark for felling those trees which should be cut. This done, the section is thrown open, and wood-cutters are free to select among the trees marked for felling, any trees they like, and to take out a license for them. Those trees which will not suit one wood cutter may answer the purpose of another, and as all work will be concentrated within a limited area, woodmen will utilise trees which they would not have the chance of getting in a forest entirely closed after excessive working.

"To pay for a license and take possession of a tree, there must be a basis of payment. For this purpose the forest officials, after marking the trees selected for felling, measure them standing (in circumference and height), number them, and calculate their cubic contents and their value at current rates. Many of these trees contain but little workable timber; for these the price is very low. A wood-cutter who formerly found it difficult to pay £1 10*s*. at George or Knysna, or £1 at Tzitzikama, for a license, can now get a license for a few shillings. If an error be made in measuring the value of the cubic contents of the tree standing, Art. 14 provides the means of rectifying it.

"The total of the trees marked up to date in the Knysna and George Forests, is greater than the mean of the previous annual cuttings.

"The prices payable for wood have been unified, and are now the same for Tzitzikama, George, and Knysna. It is only just that this should be so, the cost for living, and the outlets for wood, being similar in the three districts. Generally, the prices for wood under the new tariff are less than under the old; the only notable exception is that of stinkwood. With regard to this wood, the large margin of profit which existed under the old tariff between the cost of the wood in the forest and on the market, is very remarkable. The comparatively excessive profit obtained from cutting stinkwood was the chief cause of this species having been so overworked. The best means of stimulating the sale of other species, and thus obtaining a regular and profitable market for working the forest, is to raise the price of stinkwood. If the prices for different species of wood in the forest do not correspond with the prices on the market, the wood-cutters will all endeavour to obtain those species which, on working, will yield the largest margin of profit, and will neglect those which will yield the least profit. This would reproduce on a small scale, within each coupe, the very evils which a faulty management has produced on a large scale in the forests, to remedy which evils, is the object of the new regulations. The disproportionate demand for stinkwood will probably continue even at the enhanced rates of the new regulations, and should this be the case, it will show that the rates for stinkwood are still relatively too low.

Part II.—Practical Details.

"1. There will be a sufficient number of series to provide for one section being always open near each locality where wood cutters have established themselves.

"2. The area of a series will be between 400 and 1,000 morgen; it will rarely exceed the latter figure, nor be less than the former, except in the case of a small isolated piece of forest which cannot be conveniently grouped with another.

"3. The first sections of a series opened, should enclose about $\frac{1}{20}$ of the contents (Art. 1, Regulations). If the land is uniformly covered with trees, and equally fertile throughout, $\frac{1}{20}$ of the contents will exactly cover $\frac{1}{20}$ of the area.

"If one part—say half, for example—is without trees or exhausted, $\frac{1}{20}$ of the contents, cut down in the best place, would only cover half $\frac{1}{20}$, or $\frac{1}{40}$ of the total area, and the section should not be extended beyond that proportion.

"If a series, A, contains both North and South aspects, the sections (n) facing the North, should generally have an area of $\frac{1}{10}$, $(\frac{n}{10})$, *more* than $\frac{1}{20}$ of the total area $\frac{A}{20}$, and should be $\frac{A}{20} + \frac{1}{10} (\frac{A}{20})$; and those facing the South, $\frac{1}{10}$, $(\frac{n}{10})$, *less* than $\frac{1}{20}$ of the total area $\frac{A}{20}$, and should be $\frac{A}{20} - \frac{1}{10} (\frac{A}{20})$. So that by adopting this plan, sections with a South aspect will be $\frac{A}{10}$ smaller than those with a North aspect, unless there are other reasons to the contrary. In one word, areas of sections should vary according to the distribution of the trees, character of the soil, aspect, or any circumstances which influence their productiveness.

"4. As a rule the first section in a series will be opened in that

portion of the series best able to meet the wants of the wood-cutters of the locality; the sections will be ranged in regular order, beginning with the section first opened.

"5. No tree, without special reason, is to be marked for felling within 30 yards of the edge of the forest, or within 10 yards on either side of the top of a ridge within the forest.

"6. The selection and marking of trees to be felled, should be done with the greatest care, and in order that no trees may be overlooked, the work should be done in narrow lands, called 'virées' in forest language; special instructions have been given on this point.

"7. The young re-growth of forest species will be examined, and the better the re-growth, the greater will be the number of old trees marked for felling. As far as it can be done without injuring the development of the re-growth, all well grown trees from 20 to 50 years of age will be reserved; the remaining trees will be marked for felling.

"8. No poles standing alone, nor any seedling or sapling of a timber tree, should be marked for felling.

"In a group of poles, most of them may be marked for felling, except the thickest and straightest. The poles so left uncut are not to be more than three yards apart.

"9. When a large tree has been marked for felling, trees near it should also be marked for felling which appear likely to be injured by the fall of the large tree.

"10. Particular attention is always to be paid to stinkwood, in accordance with special instructions given about this species.

"11. The poles referred to in the Regulations should be obtained from saplings which are over-crowded, or suppressed, or which from some other cause cannot be expected to develop into useful trees. These poles are such as can be used for disselbooms, long-wagons, &c. Smaller poles, only suitable for fencing, &c., are termed spars, and are charged at lower rates in the new Regulations.

"12. In measuring trees the diameter will be taken with a 'diameter gauge,' graduated from 2 inches to 2 inches.

"The height of the trees is estimated by eye. The total height of the clean stem, or bole of the tree is entered first, and then the total height of serviceable stem; the estimate is made so as to be always below, rather than above, the true height.

"13. In calculating the cubic contents of a tree standing, the taper of the trunk will be allowed for according to the average taper of trees of that species, in the same forest. The average taper for any species will be found by felling a certain number of trees in each forest, and measuring the average decrease, in girth per 10 feet of length.

"14. The cubic content of the squared log is taken at 60 per cent. of the round log, calculated as above.

"15. On the demand of the license-holder, and from time to time, in order to verify measurements, a second measurement prescribed by Art. 14, Government Regulations, will be taken by the Ranger, and noted in a book kept for the purpose.

"Particulars of this measurement will be endorsed on the back of the license in any case in which the license-holder can show that he is a loser by the original measurement. If, on the other hand, he is a gainer, no notice will ordinarily be taken of the difference; but in case the difference may be large, the matter will be referred to the

Conservator, who, should it appear necessary to do so, in order to avoid injustice to the other license-holders, will issue orders for the recovery of the excess value.

"The second measurement prescribed by Art. 14, will only include sound wood. Where there is any doubt as to the soundness of a piece of timber, its measurement will be deferred till it has been cut up. But in any case the old tree, sound or unsound, is the exclusive property of the license-holder who bought the license for felling it.

"16. When issuing licenses, the Conservator or officer in charge, *will point out that in order to be relieved of the liabilities stated in* Art. 18, Government Regulations, the holder of the license must observe the following rules:—

"In cases where it is absolutely necessary to cut down trees not included in his license, in order to reach those for which he holds a license, he must point this out to the officer in charge of the section when he presents the license, and request him to mark those trees it is necessary to cut down, which are of any use for poles, spars, &c. These the wood-cutter must remove close to the ground and lay in piles along the side of the path at places indicated, and he must in every particular follow the directions of the officer in charge (see Art. 17).

"Trees or branches damaged by the fall of those licensed to be cut, *unless through carelessness, must be properly pruned* and trimmed if they can still be preserved, but if the officer in charge is of opinion that they cannot thrive, they must be dealt with in the manner mentioned above.

"17. The officer in charge, after registering each license, must make a mark on every tree granted, and must take an exact note of all wood which he has found, without doubt, it was impossible to avoid cutting down. When the use of poles is absolutely necessary to render the slip-paths available, he should only authorize the use of those already cut down, which have no saleable value, either on account of deformity or species, especially reserving those suitable for wagon work (disselbooms, long-wagons, &c.)

"At the end of every week the officer in charge should send the *Conservator a statement* of wood so cut down, showing how much has been used for the slip-paths, and how much is available for the Conservator to include in future licenses.

"18. The trees must be cut as close to the ground as possible, and in no case must the stump left on the ground after felling a tree, be more than 6 inches in height from highest point of the ground to the highest part of the stump.

"In cases where a tree has more than one stem, the distance (6 inches) is to be measured from the point of divergence."

III. NOTES, QUERIES AND EXTRACTS.

ROOTS.—We reprint from *Nature* the following abstract of a lecture delivered by H. Marshall Ward, M.A., Fellow of Christ's College, Cambridge, and Assistant Lecturer in Botany at Owen's College, Manchester. It gives in terse popular language some of the main facts known about the growth and functions of roots:—

In treating of the roots of plants this evening, I may request you to dismiss from your minds any expectations or apprehensions of marvellous descriptions of tropical or rare roots on the one hand, or of a list of the peculiarities of various kinds of roots or so-called roots on the other, though it is not improbable that some of the facts will be, in part at least, new to some of you, as they certainly are to many people. I do not propose even to put any new discoveries before you. It has seemed much more to the purpose to show, as well as time will permit, that a vast amount of interesting and important information can be derived from a proper and systematic study of the roots of a common plant—information, moreover, which is important alike to the scientific botanist and to the practical agriculturist, two people who find they have more and more in common each day they come to know one another better. As the diagrams must in part have told you already, I propose that we meet on ground familiar, to a certain extent, to every one; and the sequel will show, I hope, that we have in no way acted unwisely in taking each other into confidence on the subject of an ordinary root, such as is well known to all of us. So much is this the case, that our study may be confined for the most part to the root of the common broad bean and a few other plants of our gardens.

[The lecturer then shortly described the germination of the common bean, maize, and a few other plants, and illustrated by diagrams the mode in which the first or primary root of the bean seedling emerges below, as the young seedling shoot (or "plumule") prepares to force its way upwards to the light and air. Next followed a short consideration of what this root may be said to be.] Anticipating matters to a certain extent, it may be shortly described as an organ for fixing the rest of the plant to the substratum, or soil, from which it absorbs certain food-materials. By confining our attention to this typical and well-known form of root, we may avoid any complexities resulting from the consideration of the more extraordinary cases occur-

ring among the lower plants, or among curious aërial epiphytes, parasitic or otherwise, and other abnormal forms—forms which would demand several lectures by themselves.

The roots we have to consider, then, are organs for anchoring the rest of the plant firmly into the soil, and for absorbing certain matter dissolved in water from that soil. Obviously, we may do well to see, first, how the root gets into the soil; and secondly, how it accomplishes its objects when there.

When the young root first peeps forth from between the coats of the seed, it is seen to have its tip directed downwards towards the centre of the earth. Now this is not an accident; for if the seed be turned over, so that the apex of the root is made to turn upwards, its tip soon bends over, and again becomes directed downwards. [Mr. Ward then proceeded to explain, as shortly as could be done without detailed experimental evidence, that this persistent turning earthwards of the young root is due to a peculiar property, almost of the nature of a sensitiveness or perception to the influence of gravitation, and is not due merely to the weight of the organ.]

Next, evidence has been obtained to show that the tip of the root has a slightly rocking or swinging movement, which is more or less of the nature of the movements so well known in the case of the stems of twining plants; the tip of the root, in fact, not only moves earthwards, but tends to describe a very steep spiral as it does so. These successive very slight noddings to all sides of the tip as it proceeds in a line directed towards the centre of the earth are extremely slight, it must be borne in mind, but they may aid the point of the root to wriggle its way between the particles of earth in a loose soil, or to run down any crevice or hole it meets with.

Thirdly, in addition to its determined tendency to descend, though in a very slightly spiral course, the tip of such a root as we are describing has been found to be peculiarly sensitive to the contact of solid bodies. This extremely curious phenomenon could only be fully described by references to experiments and matters which we have scant time for. It must suffice, therefore, to state that there is evidence to show that the *extreme tip* of the root, on coming in contact with a hard resistant body, is caused to turn aside *from* that body, and if it comes simultaneously into contact with two bodies, one of which is harder than the other, it is caused to bend away from the harder of the two. This property is all the more curious because, at a portion of the root a very short distance behind the tip, contact with a solid body causes that part of the root to curve *over* the touching body, much in the way that my finger is now curved over this wooden pointer. As already stated, time will not admit of our examining these very remarkable matters more closely—they form subjects for lectures in themselves.

But we have not yet finished our survey of what these sensi-

tive tips of the roots are capable of. Experiments show that they turn towards a wet surface or atmosphere—a fact of great importance, and one which no doubt lies at the base of the explanation of the choking up of drain-pipes, &c., by the roots of neighbouring trees. Further, the apex of the root of such a plant as the bean we are considering avoids the light—avoids it as energetically as the leaves and green parts turn towards it. The two facts thus tersely put, *viz.*, that the tip of the root tends towards a damp spot and avoids an illuminated one, are of course also in agreement with the rest of the behaviour of our germinating bean, and hence the root descends into the damp, moist, granular soil.

It is now time to see what sort of structure this wonderful root-tip possesses, and to inquire whence comes the impulse which drives it forwards into the soil—for it will be seen that while the forces producing the various curvatures which have been referred to tend to guide the apex of the root downwards between the particles of soil, towards the darker, moister, deeper parts, they cannot be expected to drive it into the soil.

In the first place, the tip is a firm, conical, smooth body, covered with a slippery, loose root-cap, as seen in the diagrams. Now, it cannot be too carefully borne in mind that the true tip of the root, beneath the covering cap, is resistant and somewhat elastic ; it consists of multitudes of minute tightly-packed cells, each densely filled with protoplasmic substance containing very little water, and of a consistency resembling in some degree that of a well-made, hard-set jelly. Perhaps, indeed, a better idea of it may be gained if the conical tip of the root is compared to a firm, resistant jelly, cut up by delicate partitions into multitudes of minute blocks, which, however, are not separated from one another at all. In any case, it is clear that such a cone, if steadily and slowly driven by a persistent force from behind, is admirably adapted for penetrating between the particles of soil, especially if we bear in mind the following facts : (1), the cone is protected by a slippery cap of loose cells, which prevents the abrasions of the particles of soil from injuring the cells beneath ; (2), the driving force is steady and continuous, and directed vertically, *i.e.*, along the axis of the cone ; (3), the tip oscillates slightly from side to side, and is thus probably (though not to any very great extent) insinuated between the earthy particles, no doubt being aided to a certain extent by other properties to which allusion has been made.* It is of course obvious that the last thing we should expect of such a cone is that it could take up quantities of water from the soil : its structure is clearly in no way adapted for such a purpose, if

* This oscillation can obviously have very little, if at all any, effect. The lecturer has omitted to refer to the curling up of the root behind the zone of elongating cells, which curling up will be found fully described in Sach's new work *Vorlesungen ueber Pflanzenphysiologie.*—[ED]

only from the fact that there would be nowhere for the water to effect an entrance.

And now comes the question, What is this steady, continuous driving force from behind? Well, it is due to the simultaneous elongation of the hundreds of thousands of little cells situated a short distance behind the more rigid cone we have just examined. No doubt it seems a hard fact to grasp—that the absorption of water, and the intercalation of minute particles of substance in the interior of the cells shown in this diagram should be capable of steadily driving the apex of the root into the soil; but it is a fact nevertheless. Perhaps you will apprehend the matter more clearly if I offer you a well-known illustration which, it is true, does not exactly cover all the facts, but which will, at any rate, aid you in overcoming some initial difficulties. You are well aware that a wedge of wood driven firmly into a crack in a rock and then moistened, swells, and that it may swell so powerfully as to fracture the rock; very well, the elongation of the cells behind, which steadily drives the firm cone of the root forwards, is to a great extent due to the absorption of water, which causes each cell to grow longer. I say to a great extent, because, while the water is, on the one hand, absorbed in a slightly different way and enlarges the volume of each cell to a much greater extent, there are, on the other hand, forces at work which cause new particles of substance to be added to those originally composing the cells, and so fix the cells, as it were, in their condition of greater elongation, strengthening them at the same time. But this is not all. Besides growing longer, and thus driving the apex steadily forwards, the cells behind increase in diameter, and so push aside the particles of the soil with a force which would astonish you if I entered into figures; this, however, can only be adverted to here, since we must now pass to the explanation of one or two other points.

It is clear that, great as is the driving force supplied by so many elongating cells—and, of course, it is upon the simultaneous action of countless thousands of cells that the driving power depends—it would soon cease to be of much use unless a holdfast were insured at some point behind. This brings me to the consideration of an extremely important matter, and one on which I hope to make you quite clear. At first, while the root is still very young (as in this diagram), the weight of the seed above, with that of any soil covering it, seems to suffice to afford the necessary points of application; and this will doubtless be supplemented immediately afterwards by the increase in diameter of the upper part of the root.

When the root has attained some little length, however, a striking change takes place in its behaviour to the surrounding soil. First, let me call your attention to the following points, as illustrated by these diagrams. When the young primary

root has attained a length of about 4 to 6 or 8 inches—depending on circumstances which we need not occupy time in examining—the older portion nearest the seed has ceased to grow in length, and its surface is becoming clothed with a dense covering of very delicate hairs, which will be referred to in future as the "root-hairs." Each root-hair is an extremely slender sac—a sort of long tubular bladder, in fact which possesses in virtue of its peculiar organisation an extraordinary aptitude for taking up water, and for attaching itself to the particles of soil with which it comes in contact. These facts are well illustrated by reference to these diagrams, to which I wish your attention for a few minutes.

From the delicacy of these root-hairs, and from their springing at right angles from the surface of this part of the root, radiating in all directions between the particles of soil, to which they immediately proceed to glue themselves, it is obvious that they are saved from being torn away as the tip of the root is slowly driven forwards between the particles of soil; if they were to arise on the tip itself, or on the parts which are elongating behind it, they would infallibly be removed by the abrasion of the particles of soil. Instead of this, however, they become developed on the parts behind in successive multitudes as those parts cease to elongate.

At the same time, the thousands of points of attachment established by the root-hairs afford the holdfast which becomes more and more necessary as the apex of the root is driven further and further forwards, and as the weight of the aërial parts of the plant, with their increasing surfaces exposed to wind and weather, become larger.

Meanwhile, leaving aside for the moment the consideration of how these millions of root-hairs take up the water and food-matters from the soil, the young root has been making preparations for obtaining a still firmer and wider holdfast on the soil, which will, at the same time, enable them to absorb water and food-materials at millions of new points further and further removed from the centre at which the primary root commenced its operations. To understand this, I must call your attention to this diagram, showing how the branching of the root proper is brought about. In the interior of the growing root a number of cells begin to multiply at certain points, and to form the young beginnings of lateral roots or rootlets; further back you see these young lateral roots upheaving the tissues of their parent root as minute knobs. By this time, however, these portions of the mother root have ceased to grow in length, and thus the tender little tips of the lateral roots can protrude and be pushed into the soil around without danger of being dragged off or injured, as they would inevitably be if this part of their mother root were still actively elongating. Notice carefully the exquisite adaptation to the circumstances, though brought about

in a slightly different manner; no time is lost in the preparation of the young root branches within the tissues of the parent root, but the tender tips, as in the case of the root-hairs, only proceed to grow radially into the surrounding soil when the growth of the mother root in a direction across their long axes has ceased.

Time will not allow of our examining these matters more in detail; but I cannot avoid calling your attention to the fact that these lateral roots are sensitive to gravitation in a manner different from the primary root—they grow, not straight down towards the centre of the earth, but across the vertical, it may be more or less inclined, in different cases. In other respects they resemble the primary root generally, in their turn producing root-hairs and daughter roots, which radiate from them in all directions into new portions of the soil, as shown in this diagram.

I need not do more than point out to you that it would be difficult to conceive of a series of adaptations better calculated to insure that the various parts of the root-system come successively in contact with the whole mass of soil traversed; and when your eyes follow mine over this diagram, you will agree that matters have become so arranged, so to speak, between the roots and the soil, that every part of the latter is laid under contribution. Notice how this vertical cylinder of earth is first bored through by the primary root, and then traversed in all directions by the root-hairs, in a wave, as it were, passing from above downwards. Next come the lateral roots, burrowing in all directions from the main shaft, and each in turn demanding toll from the cylinder around it by means of its wave of root-hairs. Then follow tunnelings along the lengths of each of these rootlets, and on all sides at right angles to them, until every nook and cranny has been investigated by these enterprising rootlets and their prying root-hairs. Quite apart from all else, therefore, the root-system obtains a greater and greater holdfast on the soil by driving its tips in on all sides.

But I must now draw your attention to some matters which throw even more light on our subject. The root-hairs, as they develop successively from above downwards on the primary root, or on the lateral rootlets, come into the closest contact with the particles of soil—contact so close and firm, in fact, that they cannot be torn away without injury. There are experiments to prove that their cellulose walls become actually moulded and gummed on to the solid particles of quartz, slate, and other rocks of which ordinary soils are composed, and this diagram shows how we can lift up a relatively large cylinder of soil adhering to the root-hairs of a young seedling.

Now you are probably aware that the sort of soil in which a healthy plant flourishes contains air-bubbles as well as water in the interstices between the particles, and into which the root-

hairs become insinuated. Bearing this in mind, you will have no difficulty in understanding from the diagram how the root-hairs absorb the aërated water necessary for their well-being. I need simply make the additional remark that each little bag-like root-hair takes up the liquid water through its permeable walls into its interior, in some respects very much as a bladder full of a solution of sugar or salt would absorb water if placed in it.

But this water taken up by the root-hairs and passed on into the rootlets and so on up the stem (a process for which provisions are made which we cannot go into here), is not pure water; it contains, besides air, certain small proportions of the soluble matters found in all soils. It is, in fact, much like ordinary drinking water from a well or spring, which always contains some matters in solution. But the roots want certain other minerals, which will not dissolve in pure water to a sufficient extent under ordinary circumstances. Well, the root-hairs, in making use of the oxygen which they, like all other living bodies, require, give off small quantities of acids which aid the solution of these more refractory matters.

And now I have finished—not because the subject is exhausted, but because the time at our disposal is. I hope the object has been attained and that you fully realise how well worthy of study is a common living root. Not only is it instructive as a simple object of dissection, a subject upon which I have had no time to dwell, but the peculiar properties which stamp it as a living organ themselves afford material for much thought and investigation. When we go further, however, and see how the structure and the functions depend upon one another, some very curious reflections thrust themselves upon us; and if time had allowed us to look at these matters from the other platforms of view—to see how old errors have gradually been explained away on the part of observers, and how what may be called improved adaptations have arisen in the evolution of the root as an organ —these reflections would have obtained in depth. But we have taken a glimpse at matters still more comprehensive: we have touched upon that important question of the relation of the root to its physical environment, and it is not difficult to see numerous points where the struggle must have been intense before the plastic substance of the root was enabled to meet the requirements necessary before it could become a dweller in the land. The evidence of progress and adaptation to its environment on the part of the root is, in fact, so striking and conclusive, that we might take it as a text for a sermon on evolution were such necessary. I have been strongly tempted to occupy some more time with reference to the interesting phenomena shown by roots which cling to trees and walls, &c., or which rob other plants of food-materials: and had time allowed, I would have liked to say a few words about some other adaptations, such as

those by means of which roots become pulled up taut in the soil. However, these and other matters cannot be even mentioned, and, indeed, each one deserves a lecture to itself.

DATE CULTURE.

Note by Assistant Surgeon ABDUL RAHIM HAKIM, *Khan Bahadur, Assistant to the Political Resident, Persian Gulf.*

IN districts where date plantations are large and on extensive scales, the cultivators do not think seriously of the comparatively small loss, caused by the depredations of wasps, sparrows, crows, bulbuls, &c., on the sweet date fruit while forming on the palm, and as a rule do not provide against sugar-loving insects and birds, and grudge them not a share of the fruit. They say that in the good old times the cultivators were more liberal-minded, when the export trade of the date to European countries and America did not exist, and those countries had not acquired a taste for this fruit; that then any number of strangers could go to a plantation, and treat themselves *ad libitum* to any quantity of date fruit they liked, without objection. But times have changed. The demand for the fruit having largely increased, it is more taken care of, and strangers are not allowed to indulge in those liberties.

In some districts, as those of Minab, sometimes bears prove destructive to the fruit; but the cultivator effectually provides against their climbing up by tying a quantity of some thorny bush or twigs of samr (thorny acacia) or koona (zizyphus) around the stem of the palm, at some height from the ground. Against a flight of locusts he is perfectly helpless; all his attempts at driving them away, by beating about among the palms with dry date leaves, and agitating them to cause a rustling noise, &c., and his burning quantities of hay, tamarisk branches, and other rubbish to create smoke, prove of little or no avail; as, when the locusts alight and squat, they completely devour the fruit and leave the palm, in a short space of time, divested of its leafy appendages. There are two principal forms in which the date fruit is cured and prepared for commercial purposes,—*viz.* (1), "khúrma," soft and juicy; (2), "kharak-púkhta," dry and firm.

The following is the usual mode adopted for preparing "khúrma," for commercial purposes:—As soon as the dates become ripe and juicy, they are picked off the tree and gathered into a round chunam tank called "madibsah," where they are exposed to the sun and air, and throw off the excess of juice which runs through the aperture at the bottom of the madibsah, and collects in a separate jar buried underground to receive it. After two or three days exposure, when the date has sufficiently

hardened and formed, it is removed and packed in date-leaf baskets for exportation. Sometimes, when the owner does not find a ready purchaser, he stores the date baskets in a close-plastered room called "kandúl" in piles of 15 to 20 baskets; the floor is furnished with channels which convey the juice thrown off under the mutual pressure of the bags, to a large jar buried underground. Sometimes the juice is slow in draining, then the cultivator encourages the flow by pouring a little warm water on the dates while they are in the madibsah. But the dates thus treated and forced to give up their juice lose their taste and commercial value, and are not so much esteemed as those which are simply dried.

The best method for curing dates is the following:—The fruit, as soon as it has become "ratab," *i.e.*, ripe and juicy, is picked off the bunch, and spread in an enclosed plot of ground called "mustah," which is previously well beaten to render it firm, and sweeped clean to prevent dust from mixing up with the dates; or, better still, they are exposed to dry on date jowlies spread within the "mustah" from three to five days, and then collected and packed in baskets.

At El Hasa the best dates, principally Khalas, are packed in skins of 70 to 120 pounds for export. So also at Busrah, dates are packed in skins; the dates are picked for the purpose; the skins are then allowed to dry in the sun, and covered with gunny. At Bahrain and Kateef, Khalas and other dates of superior quality are put in small earthen jars, and rendered palatable by adding to them small quantities of sesame seeds and ginger powder; the jars are then sewn up in the date-leaf matting.

Now, since the European and American firms have commenced to send dates to their own countries, they have adopted the system of packing the best dates—*i.e.*, Hallowi, Khadrawi, Zahedi, and Sayer—in deal boxes of various shapes and sizes, brought ready made from those countries. The average size of a box is about 45 pounds net weight. Hallowi dates are also carefully packed in small card-board boxes, 10 to 15 of which are then put in a large deal box, which is then nailed over. The best dried dates of sound skin, and specially those which are allowed to dry on the palm, are carefully picked by a large number of labourers, principally women, boys, and girls, employed for the purpose. A certain weight of dates so picked intended to go in a box is taken; the dates are then carefully placed, one by one, in rows, so as to form layers in the box, which is lined with paper, and eventually nailed and ready for export. Some people put hoops round the boxes, and cover them with gunny, while others do not. These layers are pressed down three or four times during the filling of each box. The dates packed in boxes in layers throughout have now the best repute in the market. Small quantities of dates have lately

been shipped from Busrah in fancy baskets, but on account of the heavy freight, no sanguine hopes are entertained of this method proving a success. Hallowis keep best, but Zahidis are the brightest in colour, but soon get wormy and spoiled.

The cultivator has other modes of curing fresh dates and making preserves of them in small quantities for his personal use, and for presents to his friends, and even for sale to a small extent. "Khúrma-Shírah" is generally made of Murda-sang and Khanaizi dates. The best dates are culled and further well dried in the sun, exposed on mats or date jowlies, and protected during nights from dews. They are then washed with diluted date juice of all dust, &c., and put in a jar mixed with sesame seeds, ginger, walnut kernel, &c.; a quantity of good date juice is poured in so as to cover the whole. This is much prized by the natives. "Khúrma Seh-Roza," so named from its being fit to be eaten on the third day of its being potted. It is a rare and special preparation made at Minab from the Hilali dates. The fresh "ratab" is taken, its skin is removed by the date-leaf spine; then the coarser but soft layer of the pulp; finally, the white firm pulp which is left round the stone is further detached, and collected in small earthen pots. The mass is rendered more palatable by adding to it a quantity of pistachio and almonds &c. This is considered a great delicacy. "Khúrma Post-kandah," the skinned date.—This can be prepared from all the good varieties of dates, but it is generally made from the Hilali. As above, the skin of the fresh "ratab" is removed by the date spine; the stone is pushed out by the same; the fleshy part is gathered, and packed in large earthen pots. "Múrabba Khúrma" (date preserve).—The ripe "Kharak of Hilali," *i.e.*, before they have become "ratab" (soft and juicy), are taken; portions from both ends are sliced off: they are then deeply punctured all over by the date spine and well dried in the sun. The stone is sometimes replaced by almond or pistachio. The "Kharak" thus treated is boiled in sugar syrup to a sufficient consistence, and forms an excellent preserve, and may be bottled and kept for any length of time. "Matgúgah." The sweet and fresh "Kharak" is broken up and dried in the sun for five or six days. It is then pounded in a wooden mortar; the powder is put in boiling date juice, and mixed with sesame seeds and flavoured with cardamoms, cinnamon, &c. The whole mass is then well stirred while boiling, and removed from the fire, and further well mixed up, and finally put in jars for use.

The second form in which the date fruit is cured for commercial purposes is the "Kharak-púkhtah," the boiled date. It is prepared as follows:—When the "Kharak" has become sweet, but before it has begun to soften, the spadix, with its load of dates, is cut off from the palm and immersed in larger copper pots of boiling water, in which it is allowed to remain for a time, which is decided by the man engaged to do the work. It is

stated that the boiling is continued until the stone assumes a reddish colour; when the bunches are removed and exposed to dry in sun on mats for eight or ten days; they are then detached from the spadix, allowed to dry further, and finally put in bags for export.

The fruit of all the varieties of the date palm can thus be converted to "Kharak-pukhtah," which is dry, firm, and even hard, and does not relish so much as the "Khúrma," which is soft and juicy. This may perhaps account for the small quantity of "Kharak" usually prepared. At Busrah, "Kharak-púkhtah" is prepared in small quantities from Baraim, Sa'-Ameran, Kabkab, Maktoom, and Shakar. Baraim yields the best quality, and is said to be wholly converted into Kharak, as it does not ripen beyond the "Kharak" stage, its price being two or three times more than that of Sa'Ameran Kharak, which is also abundant. The best "Kharak-púkhtah" of Minab is from Hallowi in small quantity, but principally from Zarak and Sayer. At Lar and its neighbourhood a "Kharak-púkhtah" is obtained from the Sha-Khani date. As soon as the fresh Kharak has been sufficiently boiled, it is taken out of the water, its stone removed, and it is strung in long wreaths and hung up to dry; it is yellow, and of good taste. From various causes a portion of the date-fruit does not attain maturity, and generally drops off in a half-ripe state; becomes dry, skinny, with very little flesh. In this condition it is called "Salang," and used as food for sheep and domestic cattle; sometimes it is boiled with date stones, and constitutes a nutritious food to the milch-cow.

The age of an off-shoot is no reliable guide for its being detached from its parent for purposes of a successful transplantation. An offshoot sometimes continues at the foot of its parent several years, but under the various unfavourable circumstances of soil, supply of water, &c., it is small and weak, and therefore unfit for transplantation; while under favourable circumstances an offshoot, 3 or 4 years old, is vigorous and large, and does not usually, when transplanted, fail to strike root and survive. Hence the vigour of growth and the actual size of the young plant are taken into consideration. The average weight of the young plant most suitable for purposes of transplantation is considered to be six pounds; but larger weights are preferred, as, after striking, the plant grows rapidly, and bears fruit without much trouble and expense to the cultivator. It is averred that sometimes offshoots which have commenced to bear fruit are carefully detached and successfully transplanted. The *Phœnix dactylifera*, or the Arabian date palm, being diœcious,—*i.e.*, the male and female flowers existing on separate plants,—the conveyance of the pollen to the female flowers is essential to fertilisation and formation of the date fruit. The agency of winds and various nectar-loving flies and insects does not seem to be sufficient to effect the necessary fecundation, as in such

cases, the fruit yielded is stated to become abortive or blighted, with little flesh, without stone and totally insipid, and is termed "Shis." Consequently, human agency is considered essential for a fruitful impregnation.

The male spathe, as soon as it has attained its *full* size and maturity, which is known to the cultivator by certain signs and indications, such as a faint rustling sound, elicited when the central part of the spathe is gently pressed, or a peculiar seminal odour, detected by making a slight indentation in the marginal part of the spathe, so as to expose the flower, which is cut at its root and taken down. The enclosing spathe is slit open, and the flower-springs are gently detached from the spadix, and carefully preserved in a basket, which is suspended in a spot protected from drafts of wind ; the sprigs are allowed to dry for 20 to 24 hours before being used.

As soon as the female flowers have split open the spathe under their growing pressure, the cultivator considers it time to commence the operation of *fertilisation*. *He takes the flower-twigs* of the male palm, and deposits one or two in each bunch of the female blossom, lightly binding it up with a strip of date leaf. If the cultivator finds that some of the larger spathes have not split, to save him the trouble of reclimbing, he slits them open and deposits the flower-springs in the blossom, as before. Only very small ones he leaves untouched, to be attended to, if necessary, subsequently, when they have attained maturity. But, as a rule, he does not allow all the flower-spathes, which vary from 12 to 24, to remain on the palm and form fruit, because by doing so the fruit becomes small and degenerate, and during the next year the yield of the fruit is lessened. According to the vigour of the palm, which he knows by experience, he leaves *8 to 12 bunches to form fruit.* The excess is removed and consumed by his people and friends. The sprigs of the male flower are preserved in a dry form one or two months, and used as occasion demands. They are, however, before being used, slightly moistened with water to prevent the pollen from being scattered and blown away by the wind. It is stated that sometimes, when the male flower is not in sufficient quantity at "Kharg," the cultivators import it from Busrah. *Pollen of one year cannot, it is stated, be preserved for use during the next year, as it becomes spoiled.* When the female blossom has thus been treated with pollen, the supply of water is cut off for a time, varying from one and-a-half to two months, as excess of water is said to be detrimental to a proper fertilisation. The general method adopted for cultivating the date palm in these parts, where it is grown for economic and commercial purposes, is that it is planted in extensive groves for facilities of tending them and collecting the fruit. Spots are selected where abundance of water is available in shape of river, spring, "kanat," or well water ; in other places, where water from wells is scanty, such

spots are selected as can be irrigated by rain-torrents during the rainy season.

A plot of ground is selected according to the number of palms which it is intended to plant in a grove, which may consist of 80 to 150 or 200 palms, planted in regular rows, with a distance of 12 to 15 feet between them. The grove is surrounded by a high "bund" for purposes of admitting and retaining water in the grove, and generally regulating its irrigation, being provided with inlets and outlets to admit and get rid of excess of water, especially that from rain-torrents. For the first two or three months, after the offshoots have been planted, they are watered, each separately, by water carried to them in pots; great care is taken that no mud gets into the heart or crown of the young plant, as it proves destructive to it. After the plants have struck root they are watered once a week, a fortnight, or a longer interval is allowed to elapse, but it is essential that they must be well watered once a month. When they have grown up and have attained some age, they are watered once a month during the hot months only. At Busrah, where water is abundant from the river, deep and wide trenches are dug between the rows of the palms, and filled with water. But where water is scanty it is allowed to run down in small channels to the foot of each palm, the ground being previously well dug up, loosened, and turned over to allow of its thorough saturation.

Vegetables, lucerne, &c., are grown, as at Bahrain, in these groves, such a cultivation being considered highly beneficial in improving the soil. With this object also the soil is ploughed and turned over once a year to render it soft, porous, and permeable to air moisture. In places which border the sea, fins of awal or lookhm, a species of ray-fish, are used for purposes of manuring the palm; two or three bits are buried at the foot of each palm, and it is regularly watered once or twice a week until the whole is absorbed and disappears; or these fins are put in, and allowed to macerate in the tank of water which feeds the plantation, and the palms are regularly fed by water so impregnated. In other places where this is not available, the dung of the cow, sheep, and goats, &c., and surface sweepings are used.

The best spot for extensive date plantations would be, as at Busrah, Móhammerah, and Minab, along the river banks abounding in alluvial soil. Excess of water generally is said to spoil the date fruit, and if the plantations become flooded and continue so any length of time by any very unusual rise of river waters, not only is the fruit damaged, but the palms have been known to die. So also damp air, when the fruit is forming, is said to be prejudicial, as a great deal of it drops off in a green state; this green date is called "Khamal," and is given to sheep and cattle, but the poor people consume it with fish. Moderately dry winds are said to be very beneficial. To secure

a vigorous growth to the palm, as also to obtain materials for economic purposes, the following points require to be attended to. As the date palm grows each year the lower whorls of the leafy stalks, as their vitality diminishes and they become dry, are chopped off; the long stalks called "gúry" are made into jowlies for covering sheds, roofs of houses, and various economic purposes. Their lower thick ends, called "tapúl," are used for fuel, but those which are broad and light are used as floats for fish-nets.

The flower spadix and its spathe must also be removed. The green spadix, when well beaten with billets of wood, yields a quantity of fibre useful for rope-making. In a dry state it is used as fuel, but if allowed to macerate and soften in water on being pounded between billets of wood, yields fibres for ropes. From the fresh spathe, called "Tara," is obtained the "Tara" water, by distillation. It is of a strong but agreeable smell, and is prepared at Busrah and Bahrain; sold in carboys at one and-a-half to two rupees each. It is made into a sherbet, and is greatly prized by the Arabs and Persians. The young offshoots sprouting at the base of the palm, if they are not intended for transplantation, must be removed in the spring of each year, as they prevent it from thriving. In the same way the buds, which sometimes form and grow from the crown of the palm, resembling the offshoots at the base, must also be pulled away, as they weaken the palm. These buds are sometimes said to have grown, and yielded fruit when allowed to grow on the palm.—*Tropical Agriculturist.*

THE SUBSTITUTION OF IRON AND STEEL FOR WOOD IN RAILWAY SLEEPERS.—A paper on the above subject, to which we alluded a short time ago, was recently read before the Institute of Iron and Steel by Mr. Walter R. Browne. After a few prefatory remarks the author said:—Every engineer who is conversant with the technical literature of Germany must be aware that the superiority of metal over timber sleepers, and their eventual substitution for them, is there no longer a matter of doubt. The fact is practically admitted on all hands; the miles of line laid with metal are counted by thousands, and the weight of iron and steel employed by hundreds of thousands, if not millions, of tons. The points which do remain in doubt, and on which controversy still rages, concern merely the precise form which the permanent way of the future is to take—whether the metal is to be iron or steel, whether the sleepers are to run lengthwise or crosswise, and what is the particular mode of fastening to be adopted for uniting them with the flat-footed rail which is the general type on the Continent.

With these questions the writer will not here concern himself. His object is to discuss solely the introduction of iron or steel

sleepers in England. Now to any one acquainted with English railway engineers it will be tolerably clear that no system is likely to meet with any favour unless the new sleeper is able at once, and without inconvenience, to replace the old one. With one marked exception, the main lines in England may now be said to be laid with double-headed rails in cast-iron chairs resting upon a transverse sleeper; and, if an iron sleeper is to be speedily adopted, it must be one which can go at once into the place from which an old wooden sleeper has been withdrawn, utilizing the same rails, and, if possible, the same chairs as before. This being so, the whole subject of longitudinal sleepers (which have met with much favour in Germany) may here be left out of discussion. In the single exception alluded to above, namely, that of the Great Western Railway, such sleepers should indeed be of special utility in replacing the very expensive oak longitudinals which are in use on that line; and probably the subject has already attracted the attention of the engineers of that company. But, for the present, attention may be directed to cross sleepers only. For the same reason, the bowl sleepers so largely used by Mr. Livesey, Mr. Batho, and others, and the bowl-shaped cross sleepers now being introduced in India by Mr. A. M. Rendel for flat-bottomed rails, will not here be discussed.

Now the experience in Germany, which by this time is very large, enables us to lay down with confidence the following statements :—

Firstly, the corrosion of the sleepers, as to which fears were once expressed, is found to be insignificant. Like the rails, they do not rust so long as the traffic is frequent and regular; and no shortening of their life is to be feared from this cause.

Secondly, the elasticity of the road, as to which doubts have also been expressed, is perfectly satisfactory, no complaints having been heard as to hard running. This will be a matter of little surprise to any one who reflects that iron or steel is in itself a far more elastic material than soft wood, and retains that elasticity immeasurably better under the conditions of daily use.

Thirdly, the connection of the rails to the sleepers has proved a matter of some difficulty, and many ingenious and more or less complicated devices have been brought into use. Satisfactory results have been attained; but this does not concern us at present, because we have to do, not with flat-bottomed, but with double-headed rails. Such rails can only be secured in chairs, and these chairs rest, of course, on the flat top of the sleeper, and can be bolted or rivetted to it as desired.

Fourthly, the point which in Germany has been found to give most trouble is the tendency of the sleepers to shift endways when laid upon sharp curves. This question is ably

discussed in a recent paper by Herr Meyer, of Berlin (*Railway Organ*, 1884, p. 9). He observes that wooden sleepers offer greater resistance than iron ones to such endway motions, for *three reasons. In the first place*, their weight is greater, and they are therefore, less disturbed by sudden shocks. *Secondly*, their ends have a much larger area to bear against the ballast, in which they are in general deeply embedded. *Thirdly*, their co-efficient of friction with the ballast is very much higher, not merely because timber is rougher than iron, but because the sharp gravel actually bites into the soft wood, as it cannot do into the hard metal. The iron sleeper bears upon the ballast only at a few points, and is thus easily movable. In addition, the vibration and the churning of water below the sleepers frequently turn the bed into a layer of greasy mud, over which sliding is easy.

In Germany this difficulty has been overcome in two ways; either by bending down the ends of the sleeper, or by rivetting angle-irons or other dividing plates to its bottom. The first is not very efficient; and the second, though successful, adds materially to the weight and cost. Herr Meyer's own suggestion is to put the sleepers in pairs crossing each other in the form of a St. Andrew's Cross. One of them is of course cranked up in the middle, so as to pass over the other, and is rivetted to it. This, though it would no doubt be efficient, involves a decided complication; and in point of fact nothing of the kind seems necessary on English railways. In the discussion above mentioned before the Institution of Civil Engineers, Mr. Wood called attention to the greater length of English as compared with Continental sleepers (9 feet and 7 feet respectively), and showed two diagrams. Assuming, as is no doubt the case, that there is always a certain shrinking of the ballast under the rails, an inspection of these diagrams will show at once how much more liable the short sleeper is than the long to such endway shifting. If we investigate what the tendency to such shifting is, we find that, supposing a train to pass at a speed so high as 60 miles an hour round a curve of only 10 chains radius, the so-called centrifugal force or outward pressure will not exceed one-third of the weight in motion. When we consider the resistances to be overcome before a sleeper 9 feet long can move endways through the ballast, and also take into account the elevation of the outer rail, it is clear that the co-efficient of resistance will in all ordinary cases be much greater than this. Moreover, English railways have a great advantage in this respect from the much coarser and drier nature of their ballast. No such greasy surface of mud as Herr Meyer describes can be formed in the clean gravel, burnt clay, or broken stone which form the ballast of English railways.

The writer has dwelt particularly upon this point, because it is the only one which appears at present to present even a sem-

blance of difficulty; but here, as in all similar cases, experience is the safest guide, and as a matter of fact a number of Mr. Webb's wrought-iron sleepers, which are laid in South Wales on a curve having a radius of only 10 chains (660 feet) and on a gradient of 1 in 40, are reported to show no signs whatever of endway shifting.

The sleepers just mentioned may now be described, as forming the most successful instance, and on by far the largest scale, of the application of metal sleepers in this country. They were shown by diagrams, and by the kindness of Mr. Webb, to whom his best thanks are due, the writer is enabled to give full particulars of them. It will be seen that in the cross section the original shape introduced by Vautherin now twenty years ago has been retained, except that the feet are much narrower. This last is no doubt an improvement; the sleeper should not stand, as it were, upon its feet, but bear directly upon the ballast with its sides and top. These sleepers are rolled from Bessemer steel ingots 10½ inch square in a three-high mill, and come out as bars 60 to 70 feet long, which are afterwards cut into lengths. They are then punched with six holes for the chairs, as shown, the holes being punched from both sides so as to make them slightly tapered in the middle, and so ensure the firmness of the rivets. The chairs are of steel, made from crop-ends of rails and other scrap. This scrap is heated in a mill furnace and rolled into bars; the bars are cut up, whilst hot, into lengths, and each length is placed still hot in a die beneath a steam hammer, and stamped at one blow into the shape of a half-chair. This half-chair is then punched still hot, is put back into the die, and receives a second blow, which removes all burrs, &c., and finishes the manufacture. The lining-plate shown between the chair and the sleeper is also rolled out of crop-ends, and sawn up hot to the proper length. It will be seen that it is set in the middle in such a way as to give a firm base to the foot of the rail. Between the chair and lining-plate, and between the latter and the sleeper, are inserted liners of brown paper soaked in tar; these fill up any little interstices, so that no water or dirt can get in between the surfaces, and prevent any possibility of shaking loose or chattering, and bind the whole into one coherent mass. All the parts—chairs, lining-plate, liners, and sleeper—are now fitted together and rivetted up by a Tweddell hydraulic riveter. The moment this is completed, the distance between the rails is absolutely fixed, and so long as the keys are in place any spreading of the gauge (the source of so many accidents) is rendered impossible.

The keys themselves are of the ordinary kind and shape, and are never found to work loose under any circumstances. This is due partly to the elasticity of the steel chair, which follows the wood in case of any contraction, and continues to grip it tightly; partly to the recess which is formed at the centre of its

length, as shown in the section. The wood swells out into this recess, where it is not exposed to pressure, and this swelling acts like a feather on the key to prevent any endway motion.

The weight of the whole arrangement is 174 lbs., made up as follows :—

					Lbs.
Sleeper 9 feet long,		...	...	...	124
2 chairs,	...	...	...	...	28
Rivets,	...	...	...	...	5
2 lining-plates,	...	...	...	...	15
2 oak keys,	...	...	...	...	2
			Total,	...	174

The weight of a creosoted wooden sleeper of the kind used on the London and North-Western Railway, complete with chairs, spikes and screwed spikes, and felt liners, is 242 lbs.

This difference in weight and bulk might be of considerable importance in the case of shipping sleepers to distant countries.

With regard to cost, Mr. Webb's figures show that a creosoted timber sleeper, complete with chairs, &c., as described, is rather cheaper than the steel sleeper. It is to be observed, however, that, while the price of steel is ever tending downwards, the timber is gradually getting scarcer and dearer, and a very slight change in this respect would bring the two to an equality. Again, it may well be found that a somewhat thinner, and therefore cheaper, sleeper will answer all requirements. Still it will be better to accept the fact of the excess in cost, and to consider whether there are not certain advantages on the side of the steel sleeper which may make this slightly increased cost a good investment. Some of these advantages may be enumerated as follows :—

1. The life of a timber sleeper, as shown by the extensive researches made in Germany, is a very uncertain quantity, depending on the kind of wood, its seasoning, its pickling, and the conditions of ballast, traffic, climate, &c., to which it is exposed. Probably the extreme limits may be taken at one and twenty years, and fifteen years will be a very favourable estimate as an average. On the other hand, the iron sleepers laid down on the Bristol and Exeter Railway thirty-one years ago are still in use; and it does not seem possible to lay down any definite limit to the life of such a system as Mr. Webb's. There are absolutely no parts exposed to wear, and corrosion, as has been already pointed out, does not occur so long as the traffic is frequent; whilst, if necessary, it can be prevented altogether by dipping the sleeper in any tarry solution, as, in fact, is done at present.

2. There is no possibility of the gauge spreading, as it often does when the fastenings cut into the timber sleeper. More-

over the keys, as already mentioned, do not work loose. Hence the labour and cost of maintenance will be very greatly diminished, and with them the risk of accident from the causes just mentioned.

3. In the case of derailment the permanent way is far less likely to be injured than where the sleepers are of timber, and therefore liable to be cut and crushed by the wheel flanges. In an actual case (mentioned by the writer on a previous occasion) a derailed train ran some distance over a line which was laid at one part with wood and at another with iron sleepers. The result was that all damage done to the latter was repaired, and the line ready for traffic, long before the *débris* of the wooden sleepers had even been cleared away.

4. In severe weather the moisture which has soaked into wooden sleepers freezes, and the road thus becomes hard and inelastic. This is probably the main cause of the well-known fact that breakages of rails, tyres, &c., are much higher in winter than in summer. In the steel sleeper this cannot occur; and although the ballast may freeze beneath it, yet owing to the thinness and conductivity of the metal a very slight rise in the temperature above freezing point will suffice to thaw it again.

5. A last advantage, but as the writer hopes not the least from the point of view of his present audience, is that the use of steel sleepers would give employment to the capital and labour of our own country, now suffering under so severe a depression. On the other hand, there is not a single sleeper upon an English railway which has not been imported from abroad, and of which almost the whole cost has not gone to swell the resources of other and competing nations.

In conclusion, the writer feels it needful to apologize for the necessarily incomplete character of this paper, which has been prepared at very short notice in response to a suggestion kindly made by the President of the Institute. He desires that it should merely be regarded as the starting-valve, so to speak, for a discussion. But, in fact, the case appears to him so strong as to need little advocacy. The problem of metallic sleepers has been thoroughly mastered in Germany, and worked out with all the exhaustive care and skill for which the engineers of that country are celebrated; while its solution, in the particular form demanded by English conditions, appears to the writer to have been satisfactorily achieved by Mr. Webb. Nor can it be said that this solution is a theoretical one merely. Some 40,000 of these sleepers are now in use, and some of them have been down for a period of three years. They may fairly claim, therefore, to have answered the test of practical work. It remains to ask why their introduction is still so slow and so doubtful. Is the answer to be found in the remark made by an eminent engineer during a former discussion, in which he congratulated English railway companies on the caution and slowness of their advisers,

whereby they had avoided the failures which in many cases had been experienced on the Continent? If English engineers have thus begun to take pride and to assume credit for being in the rear of progress, instead of in the van, it is not to be wondered at if the manufactures of England are threatened with ruin, and our industrial supremacy with defeat. Mr. Webb has, however, already falsified the prophecy then made, that no engineer of sound judgment would ever entrust to iron sleepers the carrying of such a traffic as that of the London and North-Western Railway; and the writer has been glad to learn within the last few days that the engineers of other lines are beginning to follow in the same track. He hopes, therefore, to see the time, before many years are over, when the importation of timber into England for the making of sleepers will be looked back upon as a curious delusion of the past, and useful work be found for our steel works at home.—*Timber Trades Journal.*

THE AMERICAN FORESTRY CONGRESS.—The annual meeting of the American Forestry Congress at Saratoga, N. Y., commenced on September 16th. The following subjects were on the agenda paper:—

1. The mercantile significance of the Adirondack forests for the State of New York.
2. Statistics of deforestation of the Adirondack region.
3. Present condition and comparative value of the Adirondack forests at present and under more systematic management.
4. Attempts at legislation for the benefit of the Adirondack forests.
5. Hydraulic influences of the Adirondack forests.
6. Causes of, and provisions necessary to prevent, destructive fires in the Adirondacks.
7. Management of mountain forests.
8. Methods of reforesting waste places, mountainous and stony grounds.
9. *Forest supplies of the eastern States.*
10. Suggestions for a forest policy of eastern States.
11. Canada's method of lumbering.
12. "Pruning the forest."
13. Formation and work of local forestry associations.

BRAZIL RUBBER TREES.—A law has been passed by the Province of Amazonas, in Brazil, prohibiting the tapping of rubber trees above 2½ mètres from the ground, the tapping of young trees, or those less than twenty-five years old, and the injury or destruction of young trees. The fine is fixed at 1,000 dollars for each infraction, while a premium of 1,000 dollars is offered for each thousand trees planted and cultivated, at two years of age, besides other favours to cultivators. To guard against

foreign competition, an export duty of 5,000 dollars is levied on every rubber plant, and 100 dollars on every kilogramme of rubber seed exported.—*Timber Trades Journal.*

INFLUENCE OF FORESTS ON CLIMATE.—From observations made since 1873 at thirteen Forest Meteorological Stations in Prussia, Professor Müttrich draws the following conclusions :—

(i). Forests exercise a positive influence on the temperature of the air.

(ii). The daily range of temperature is less in the forest than in open land outside, and more remarkably so during summer than during winter.

(iii). Forests in leaf exercise during the day a more powerful cooling influence than they exert a warming influence during the night.

(iv). The maximum temperature in the forest is reached from half an hour to one hour later than outside in the open.

(v). The influence of forests on temperature is greater in summer when they consist of broad leaved species than when composed of conifers, but in winter when the former are leafless the influence of the latter is greater.

OBITUARY.—We regret to have to announce the death of Mr. Philip Arthur Swade Sheppard at Coimbatore, on 11th February, of typhoid fever, at the early age of 21. This young and promising officer had arrived from Nancy only in December last, and was posted to the Madras Presidency as an Assistant Conservator. He was a son of the well known Bombay Civilian, and his death has cast a gloom over the whole station, where he had become very popular.

BURMA.—The Tounghoo correspondent of the *Rangoon Times* says that grave fears are entertained for the safety of Mr. James Nicholl Pickard, the Deputy Conservator of Forests of that division. Eight months ago he fell overboard from a steamer near Bassein, and went home on sick leave for six months. On arrival at Tounghoo on his return he went into camp near the Pyoo stream. About a week ago he left his tent at midnight and has not been seen since, though every possible search has been made. It is thought that he may have been carried off by a tiger. His servants say that he was latterly subject to strange fits of abstraction and petulance.—*Pioneer.*

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Mr. BRANDIS' WORK IN THE N.-W. PROVINCES AND OUDH.

In 1863, when Conservator of Forests in British Burmah, Mr. Brandis whilst on special duty with the Government of India, wrote a memorandum on the Oudh Annual Forest Report by Mr. Read, Superintendent of Oudh Forests.

Mr. Brandis approved of the Forest Survey operations then in progress in Oudh, the objects of which were, as defined by Mr. Read –

1st. To demarcate the forests which were to be reserved *and in which no grants* of waste lands were to be made.

2nd. To render possible a regular working of the forests by rotation.

But he objected to some of the details under which these principles were being carried out, considering many of the proposed tracts of reserves, of which there were 68 with 418 miles of boundary, as too small.

He also considered the girth of 4 feet 2 inches, which had been fixed for exploitable sál timber, as too small, and reminded the Superintendent that certain old trees must be left for seed, shade, and to retain moisture in the soil.

He highly approved of climber cutting in the Oudh forests, and in the resolution of the Government of India on the Oudh Report, it was directed that climber cutting should be extended over the whole of the forests with the least possible delay. We have next a report to the Oudh Government, by Mr. Brandis, dated July 1865.

The main points on which he had been called upon to report were :—

1. Whether the working of the forests needed restriction.
2. Regarding Mr. Read's plan for a bridge-of-boats across the Sárda.

He measured all the sál trees in 204 acres of forest of average quality, with the following results :—

Below 1 foot in girth.		1 foot 6 inches to 4 feet 6 inches.	4 feet 6 inches to 6 feet.	Above 6 feet.
No. of trees,...	5,645	6,955	1,190	708

giving 3·3 first class trees per acre, or 2,205 per square mile. Assuming that the sál forests between the Sárda and Koosialla rivers, which had been surveyed and demarcated, contained 150 square miles, the contents of these forests were estimated at—

1st class, 3,30,750 trees.
2nd class, 5,59,500 trees.

The next point to be calculated was the time which it would take to bring up the 2nd class trees to the 1st class *category*. The difficulty in counting the rings of sál trees prevented any certainty on this question. But in the case of certain planted trees of known age, and of two trees in the Kótri Dún, Garhwál, in which the annual rings were considered conclusive as to the age of the trees, the following results were published by Mr. Brandis :—

Age.	Girth.	Locality.
13	2′ 3″	Average of 33 trees in Sahárunpur Garden.
25	5′ 9″	Garden near Calcutta.
30	4′ 6½″	Sahárunpur Garden.
35	6′ 7½″	Sahárunpur Garden.
50	3′ 0″	On the slope of a hill in the Kosilla valley, Kumaon, average of 20 trees measured.
162	8′ 2″	At 2,500 feet elevation, in the Kótri Dún Forests, Garhwál, average of two trees measured.

Mr. Brandis admitted he was not justified in accepting the data for the garden-grown trees for the forest trees of Oudh, for independently of cultivation and irrigation, there was the absence of forest fires to favor the growth of the former.

He also assumed that the rate of growth in the plains would be more rapid than in the hills.

He therefore assumed for an age of

15	years,	girth	18	inches	$= 1\frac{1}{2}$ feet,
50	„	„	54	„	$= 4\frac{1}{2}$ „
80	„	„	72	„	$= 6$ „
150	„	„	108	„	$= 9$ „

which would give 30 years for a tree of the second class to attain first class size.

In order to be on the safe side, however, he assumed this period to be 40 years, and estimated a yield of 8,000 first class trees per annum, styling this estimate, however, as rough and uncertain. As a temporary measure, therefore, until the forests had become better known, he proposed the following rules :—

Felling in the forests between the Sárda and the Koosialla to be restricted to 4,000 first class trees annually, on an area not to exceed 10 square miles, and the felling operations to proceed from west to east, and that the forest tract under operation should be well defined.

In no instance was more than one in four first class trees to be felled, and no trees to be felled on the edge of blanks or thinly stocked areas.

Mr. Brandis estimated that the revenue from the 200,000 cubic feet of timber which these 4,000 trees would yield, might be placed at Rs. 1,00,000, which was estimated to cover all the expenditure for felling, conversion, establishments, &c.

The estimated value of the cubic foot of sál timber was placed low, as the rich sál forests of the Oudh Terai, which had been recently ceded to Nepal, were then being worked on a very large scale, so that the value of round and square timber taken all together at Byramghat was only estimated at 8 annas a cubic foot.

At that time, broad gauge railway sleepers, measuring 10′ × 12″ × 6″ = 5 cubic feet, were being sold, at Rs. 3 all round, by Colonel Ramsay in Kumaon, though Mr. Brandis considered that, considering the number of rejections, the actual price realized for the sleepers did not exceed Rs. 2. He considered it a public misfortune, as good timber was scarce and had to be husbanded, that sleepers measuring 10′ × 10″ × 5″ which were used by the Bengal, Bombay and Punjab Railways, and which only contained 3·4 cubic feet, could not be substituted for the larger kind on the North-west branch of the East Indian Railway.

Mr. Brandis explains the great damage done by forest fires, and by climbers, which in the Oudh forests were counted on an area of 123 acres, and were found to have attacked two-thirds of the standing sál trees, giving 12,800 climbers per square mile, but he estimated that 10,000 would be the average number, and assuming that one man could cut 150 climbers per diem, the cost of clearing the climbers would be about Rs. 15 per square mile.

Some careful thinnings, in the denser young forests, were advocated, and also if it could be done without expense, the removal of all other trees but sál, which Mr. Brandis said would greatly serve to improve the forest.

The protective establishment proposed for the Oudh Forests was singularly small—

	Rs.
1 Jemadar, ...	15
2 Peons, ...	10
4 Guards, ...	40
Total Rs., ...	65

The demarcation merely of land actually covered by sál forest was deprecated, and Mr. Brandis advised that the boundaries should be made as simple as possible, and should include large tracts of grass land, in which short leases for cultivation might be given, but that these lands enclosed within forest blocks or separating adjacent blocks should be under the control of the Forest Department. Planting of sál, sissú or tún was also advocated in the grass lands.

As regards the sissú forests, Mr. Brandis examined an area of 62 acres at Newal Khan—

Here were 175 1st class trees,
" 352 2nd " "
" 418 3rd " "

and 25 acres covered with forest of a poorer description.

Besides these, 716 stumps on the ground, showed that the forest had been better stocked previously, but the size and growth of the first class trees was not good.

Some useful figures regarding the growth of sissú on the Eastern Jumna Canal were also given, and are as follows:—

Age in years.	Girth at 5 feet.	Cubic Contents.
35	5′ 11″	92 c. feet.
"	5′ 8″	67 "
"	5′ 4½″	72 "

Mr. Brandis assumes that if sál will form a girth of 6 feet in 80 years, sissú will do so in 50 or 60. Regarding tún from the Eastern Jumna Canal plantations, we have the following figures:—

Age.	Girth at 5 feet.	Cubic Contents.
35	7' 2½"	105 c. feet.
"	6' 1"	82 "
"	7' 10"	139 "

He proposed that the Superintendent be styled Conservator, and that his head-quarters should be at Lucknow, except during the rains, when he might reside in the hills, and that he should be directly subordinate to the Chief Commissioner, and not to the Commissioner of Fyzabad, as had been suggested.

The Chief Commissioner approved of most of Mr. Brandis' suggestions, and the foundations of Oudh Forest Conservancy were thus laid on a sound basis.

We have next a paper on the Rohilkhand forests, which Mr. Brandis estimates as covering 1,023 square miles out of a total area of 13,373. 436 square miles of this area were, however, private forests.

The Government forests are enumerated as follows :—

1st. The Chandi forest near the Ganges, of about 9,500 acres in Bijnor, the most valuable produce being bamboos.

2nd. The Najibabad forests, covering an area of 1,07,037 acres, also containing large quantities of bamboos.

The bamboos are all of one species, *Bambusa stricta*, and rarely exceed 2 inches in girth, or 25 feet in length, and no special protective measures were advocated, as local opinion held that even if nearly all the stems of a clump were removed in one year, still plenty of mature stems fit for cutting would be found in the subsequent one.

The Nabigarh and Amangarh sál forests of 35,184 acres were also remarked on.

In the Moradabad and Bareilly districts, there were about 37,000 acres of Government forests, mostly young sál, and in Shahjahanpur, 75,438 acres, which at that time only yielded firewood and charcoal.

In the Terai district, the area of the Government forests was placed at 175 square miles, mostly of young sál, but on a portion of this area only simal and dhak were to be found.

We have next a paper, written in 1870, on the question of the management of temporary squatters in Government forests in Gorakhpur, and the important question arises whether enclosures in a Government forest in which no rights of occupancy have been acknowledged at the time of settlement, should be under the control of the Forest Department, or of the Land Revenue officers. Mr. Brandis, who was then Inspector General of Forests to the Government of India unhesitatingly declares

it essential that such land should be under the control of the Forest Department. He goes into the general question very fully, explaining that blanks are almost invariably to be found in our forests which cannot immediately be planted out, and yet from which it is advisable to obtain revenue, and that in many cases cultivation may be made serviceable for forest purposes.

He instances proposals to grow teak toungya plantations in British Burmah, on what he calls the field forest system of the Grand Duchy of Baden, and Mr. Fenner's system of allowing cultivation to pay for irrigating land in Sindh, on which a crop of babúl was raised to stock the fields after they had been abandoned. Lands in the forest might also be granted to cultivators as in Mysore, so as to secure their services for forest working and protection.

Mr. Brandis' next work in the N.-W. Provinces was the compilation of the Deoban forest working plan for three years ending 1877-78, for the supply of fuel to Chakráta. As this work is well known to all local forest officers, and any notes on it will be too incomplete to give a general idea of the amount of detailed knowledge of the oak and fir forests above Chakráta which Mr. Brandis had acquired, we must refer our readers to the original for further information.

In January 1877, Mr. Brandis wrote a memorandum on the excessive expenditure on timber operations in the N.-W. Provinces, and showed conclusively that these works were being carried on at little or no profit to Government, whilst not being of the nature of thinnings, these excessive fellings, especially in the Bhagirathi deodar forests, were really imperilling the future yield.

The reason for these large timber works was the imperative order of the Government of India, that the Rajputána State Railway should be supplied with sleepers from the Government forests, and Mr. Greig, the Conservator, received great credit for the excellent arrangements by which he was enabled to supply 1,200,000 railway sleepers of sál and deodar at a very short notice.

Another cause which very materially increased the cost of these timber operations was that after the process of conversion had been commenced, the size of the sleepers which had originally been ordered as broad gauge, was altered to the narrow gauge.

Some idea of the very heavy expenditure which these works involved, may be gathered from the fact that Rs. 2,03,668 were spent during a period of seven years on a road in the Bhagirathi valley to render the leased deodar forests of Tihri-Garhwál accessible, and the total expenditure on this road, only 90 miles long, was about 4 lakhs of rupees.

Mr. Brandis' remarks on the future working of the forests of the N.-W. Provinces, that if a working plan be prepared,

the cuttings should be below what is fixed as the maximum annual yield of the forests, and that if no working plan is prepared, the quantity of timber cut in any block should be as small as possible, and so distributed that the growing stock of the more valuable kinds of timber may be improved.

He also adds, that considering the impoverished condition of the Government forests in the N.-W. Provinces, that no timber at all should be cut unless there is a certain prospect of a considerable surplus resulting from the operation. The memorandum closes with the wise remark that the maintenance and improvement of the forests should be the first consideration in timber operations.

This memorandum was circulated to all Local Governments, and may thus be considered to have been adopted as the guiding principle of the Government of India as regards departmental timber operations everywhere.

In May 1879, a memorandum on the grazing question in the forests of the Bhábar of Kumaon and Garhwál was drawn up by Mr. Brandis for the N.-W. Provinces Government.

It had been proposed by General Ramsay, Commissioner of Kumaon, that in re-gazetting of the Government reserves under the Forest Act of 1878, certain forests should be declared as reserved, and others, the majority, as protected forests, in order to make matters easy for the Bhábar villagers as regards grazing for their cattle, and wood and minor produce for building, &c.

Mr. Brandis strongly deprecated this plan, and proposed that areas of waste land sufficient for their wants should be excluded from the reserves, and handed over to the adjacent villages, as he considered the existence of two classes of forests, with their separate boundaries under the management of the Forest Department, as tending to allow the Forest subordinates to confuse the people and to extort money from them in a variety of ways. The following remarks by Mr. Brandis go to the heart of the question :—

"If forest arrangements are not plain and simple, they are worse than useless, and had better not be attempted. The complicated system proposed to be introduced in these Bhábar forests is sure to lead to mischief, and will not secure the protection of any of the forests, for on the other hand, the multiplicity of boundary lines, and the variety of rules and orders relating to the different classes of forests, will assuredly be used to shelter Forest Officers behind mistakes and misconceptions."

And again -

"To divide the whole of the Bhábar forests into a series of alternate blocks under a variety of notifications and rules, like a chess board, doubtless looks well on paper, but it will not serve any useful purpose; it will not secure the protection of the forests, and will lead to all kinds of oppression and extortion."

Mr. Brandis' suggestions were partly accepted by the N.-W. Provinces Government, and in the re-gazetting of the reserves, 830 square miles, comprising the more valuable sál forests, were declared free of rights, and 365 square miles were still burdened with rights, but were gazetted as reserves and not as protected forests.

In the Government of India resolution approving of the settlement which had been arrived at, attention was called to the fact that, though the old established villages at the north of the reserved forests might have rights within them, yet the new villages lately settled by Sir H. Ramsay in the northern belt of forest could only have forest rights by special grant of the Government.

In January 1879, Mr. Brandis drew up a memorandum on *the utilization of waste lands on both sides of the Jumna river* in the Agra, Etáwah and adjoining districts.

These lands were not State property, but with the example before him of what had been done in Ajmere and Mercára to restore natural forest growth and prevent the formation of ravines, Mr. Brandis proposed that a scheme should be prepared by one of the N.-W. Provinces Conservators to acquire and re-afforest say 10,000 acres of this waste land for the production of grass and fuel, and for the indirect advantages of greater atmospheric moisture and prevention of the formation of ravines.

The measures to be adopted were protection from fires, fencing and exclusion of grazing animals, and of all cutting except of grass, by the sale of which Mr. Brandis anticipated that all the expenditure involved would be recovered.

We believe that no action has yet been taken by Government to carry out Mr. Brandis' suggestions, but the plan is still under consideration, and with a wider application than for the districts referred to by him. The constitution and proper management of grass and fuel reserves in the burning plains of India is one of the important problems we have to solve.

The next great matter to which Mr. Brandis' attention was directed was the separation of the Forest School Conservatorship, and the establishment of the Forest School, and his suggestions regarding the management of the forests in the School Circle, dated September 1879, show a detailed knowledge of the Dehra Dún forests and of the hill forests beyond Chakráta, which has proved the foundation of a good system of their management. Girdling spruce and silver fir in deodar forests, and protecting deodar seedlings from the more rapid growth of the blue pine, the management of deodar plantations and those of oak and other trees on the grassy slopes above Chakráta, an estimation of the forest area required for the full supply of Chakráta, and arrangements to allow for village grazing without fires in the Jaunsár forests, the working out of deodar sleepers by slides,

and a calculation of the number of mature deodar trees in the hill forests of the Circle, all find their place in these suggestions.

Regarding the sál forests of the Dún, the gradual removal of all irregularly shaped sál trees was urged, and girdling was advocated, though this had afterwards to be abandoned, as the girdled trees were at once attacked by borers.

The uncertainty of ascertaining the age of sál trees by counting their annual rings was referred to, and greater care in ascertaining the rate of growth of sál by means of already established sample plots was advocated.

We have next a paper on the management of the Maharaja of Kapurthala's forests in the Bahraich district in Oudh. The name of the forest is Ikonah, and its area is about 16,000 acres, much of which is sál.

Mr. Brandis advocated a complete survey and demarcation of the forest, and its protection from fire. He also proposed that the boundaries should be simplified, corners being here and there given up to cultivation, and that instead of 20 Forest Guards on low pay, that a smaller number on graduated pay of Rs. 8, 5 and 3 monthly would suffice, with a Ranger in charge, who might be trained at the Debra Forest School.

The principal revenue of the forest was derived from lac, on the dhak (*Butea frondosa*) and mohwa.

Revenue from wood for domestic and agricultural purposes, minor produce and grazing, amounted to Rs. 3,300, which Mr. Brandis thought might be considerably increased.

The forest is subject to a land assessment of Rs. 3,600, payable to Government.

On the 20th August, 1880, Mr. Brandis published his suggestions regarding the working of the trans-Sárda forests in the Kheri District, Oudh, which had been the subject of his former memorandum of 1863, to which already reference has been made.

In 1863, the number of sál trees to be felled annually was fixed at 4,000, but when the forests were re-examined by Mr. Brandis and Capt. Wood in 1868, this number was reduced to 2,900 trees.

Besides these, Capt. Wood, in 1870, advocated the removal of large crooked and hollow trees, which are very prejudicial to the young growth, and which no longer produce any useful timber-increment themselves.

Capt. Wood gave the following data as the results of his counting of the annual rings of sal trees :—

Class.		Girth.	Radius.	Age.
4th,	...	1′ 6″	2·86″	14
3rd,	...	3′ 0″	5·72″	28
2nd,	...	4′ 6″	8·60″	43
1st,	...	6′ 0″	11·46″	57

x

Capt. Wood also advocated certain improvement fellings, in which every thing should be cut flush with the ground, and cattle and fires excluded at any cost.

This latter class of improvement felling was commenced in 1874, on 82 acres, all miscellaneous trees, as well as all crooked, damaged and unsound sál being removed, and only a few large sound sál trees being left for seed and all uninjured young sál trees.

The outturn was 8,331 cubic feet of sawn timber and 1,25,000 maunds of firewood, giving 100 cubic feet of sawn timber and 1,500 maunds of firewood per acre, from what Capt. Wood called indifferent forest.

These improvement fellings were not, however, continued from want of officers and failure to dispose of the fuel.

Mr. Brandis in remarking on the carrying out of the proposals of 1869, remarks that one of its essential features was the protection of the Kheri forests from fire, that this had not been done, and that until fire conservancy was assured larger fellings should not be attempted, and that the limit of cuttings must depend on the extension of fire protection.

Regarding the rate of growth Mr. Brandis gives a very clear account of the structure of sál timber which we append :—

"The structure of sál timber, on a transverse section, is as follows :— Between numerous prominent medullary rays are seen single lines of pores, sometimes in radial groups of two to three, which often are filled with resin. The structure of the wood is exceedingly uniform from the centre to the circumference. Numerous concentric lines are visible, but there is no difference in the distribution of the pores at the inner and outer edge of the belts within these concentric lines.

"Nor have I been able to discover that any additional medullary rays take their rise at these supposed annual rings, as is often the case in other woods. Narrow white lines are the only mark, by which I am able to distinguish these concentric rings. In old heartwood, these lines are sharp and distinct, but are less marked and often invisible in the sapwood. Often, a number of these concentric rings are close together, which makes it difficult to fix on one ring as more prominent and likely to be an annual ring than the others. These concentric rings are often interrupted and only partly concentric.

"I have examined hundreds of sections of sál trees in different places, and at different times, with the same results, *viz.*, that these concentric rings are extremely confusing. In many cases it was not possible at all to recognize a series of rings in a satisfactory manner; in others they could only be read on a portion of the radius, and very often, the readings on different radii did not agree. I have found such discrepancies as 56 rings on one, and 76 rings on another radius.

"Under these circumstances, nothing short of the examination of numerous sections of trees of varying but known age can lead to a satisfactory conclusion in this respect, and, unfortunately, hitherto these examinations have not given any uniform results."

Mr. Brandis advocates the selection of sample plots to determine the rate of growth of sál in Oudh.

"These plots should be ⅝ths of an acre, or larger if possible. All trees should be felled except those above 18 inches in girth, and straight, sound and vigorous, whether of sál or other kinds. The best of the trees left standing should be selected for measurement, and should be marked at a point between 3 and 6 feet from the ground, where the shape of the stem is round and regular, a line of oil paint renewed every year being the best mark.

"All trees selected for measurement should be numbered and registered."

The conclusions of Mr. Brandis' memorandum on the trans-Sárda forests are—

1st. The annual outturn, 3,000 trees, might be largely increased were the forests to be protected from fire.

2nd. As long as protection from fire is not assured, as little as possible should be cut, and selection fellings on the plan adopted in 1868 be continued.

3rd. In tracts protected from fire, improvement fellings on the plan commenced by Capt. Wood in 1874 should be continued.

4th. After protection from fire has been assured, the forests should be worked to their full extent, and the cutting out of the mature timber should be only regulated by the necessity of leaving trees to shed seed, where young growth is wanting, and by the consideration of maintaining a sufficient annual supply of timber, until the younger classes of trees have attained maturity.

5th. Valuation surveys should be commenced, and the rate of growth determined by annual measurements of standing trees, at the same time attempts should be made to determine the annual rings in saplings of known age.

Mr. Brandis' last work in connection with the forests of the N.-W. Provinces and Oudh is comprised in his suggestions regarding forest administration in the N.-W. Provinces and Oudh, dated 1st November, 1881. Commencing with the Oudh forests, in January, nearly all of which were visited, he proceeded through the Terai and Kumaon, Garhwál and Bijnor forests, arriving at Hardwar on the Ganges on the 1st April.

Thence he inspected the Sahâranpur and Dún forests, and reaching Chakráta on the 27th April, completed his tour by an inspection of the Jaunsár hill forests and the leased forests in Tihri and Bashahr.

The suggestions contain a history of the management of nearly all the forests of these Provinces, and a clear description of their state at the time of Mr. Brandis' visit, and explain in the clearest manner the principles on which they should be worked.

This memorandum, interleaved with blank pages for notes as to any changes of management and results of natural causes, forest fires, &c., on the forest growth, forms a guide to the management of each Forest division of the N.-W. Provinces, and is invaluable to the Forest officer.

It comprises 157 pages of foolscap, and embodies all the local experience of the Forest officers of the day, and is probably one of Mr. Brandis' clearest and best written works.

Forestry in India is probably on the whole no where more advanced than in the N.-W. Provinces and Oudh, where the forests from the Nepal frontier to the Punjab, follow the lower contours of the hills, and find in the cultivations and large cities of the plains a ready market for every kind of produce. This is not yet the case with forests in the east and centre of India, where frequently only a few of the better species of timber trees can be sold.

Hence the greater necessity for detail in the management of the Sub-Himalayan forests, and no divisional officer in the whole range of these forests was probably better acquainted with the details of his own forests than Mr. Brandis, who for a period of about twenty years inspected these forests from time to time, and in his suggestions has embodied the results of his own vast experence as well as that of the local Forest officers.

FOREST PASTURES IN THE DECCAN.

By R. A. Fagan, *Assistant Conservator of Forests.*

All forest officials of India who have had the advantage of the training afforded in France or Hanover must feel greatly taken aback on seeing the wholesale manner in which the State forest reserves are grazed over by animals belonging to professional graziers and shepherds, as well as the local cultivators. They very naturally enquire: how does the State expect to reafforest lands such as we have in the Deccan, with this annual system of degradation going on everywhere?

However much at first they may be surprised, they soon learn whilst administering their forests that Indian Foresters have and must submit to the continuation of this obstruction to the Deccan *reboisement* from year to year, without being able to make such appreciable reductions in the areas given out as would ultimately give promise of that very important sub-head of the Budget, *viz.*, Receipts II*d.*, being abolished as far as grazing was concerned.

I write this with the object of showing how essential it is to insist year by year on the areas closed to grazing being increased, although it may be at the expense of the budget receipts. For the great object in all State forest administration is the eventual proscription of any abuse, be it in the shape of a

privilege or right. The State forests should be worked on the latest and most scientific principles, and these can only be introduced after the entire exclusion of grazing. One great economical objection is, however, always put forward, *viz.*, the necessity of giving the people grazing as heretofore. Though practically, the objection is a very weak one, still even it should be dealt with temperately and moderately by well timed reductions made from year to year which may eventually reduce grazing to nothing. For as a matter of fact, the real quantity of fodder obtained from forests is not a tithe of what the animals of the country devour each year. Indeed, the people of the Deccan could in time be brought to do without it altogether, if only a certain amount of discretion were practised in the demarcation of the forests. That is, if only lands suitable for forests were reserved, and those only fit for pasture were left outside for the people, the latter could then, as they felt the pressure, extend their own pastures if necessary.

It should be clearly understood that I confine my remarks to the areas under *reboisement* in the Deccan; for the heavily wooded tracts of Bombay I cannot, from want of experience, make any suggestions, though in the main I hold the same opinion regarding them, *viz.*, that the grazing revenue obtainable from them is no equivalent to the increase of timber that would take place in them if left at rest. Actually, this fact may not be appreciated, or even perceived, in places where the yield and possibility are tenfold the demand, but we have only to wait and see the results when the great woods of Kanara, for instance, shall be opened up on all sides as in the Deccan.

Origin of Forest Grazing.

Lands and their Locality.—The lands now under forest control with the designations of "protected" and "reserved" were for the most part the revenue waste lands of former times. About as far back as 1850, the Bombay Government seems to have made its first important moves with a view to asserting its rights to the lignified vegetation on these lands. This movement has been continued from time to time, with more or less rapid strides, up to the present day, when we find ourselves with a thoroughly organised, but extremely undermanned Forest Department in the Deccan.

Area of reserves in the "Deshi," or "Deccani," Districts of the Northern Division, Bombay.—The lands under the control of the Forest Department in the five following Deshi talukas amounts as follows in round figures:—

In Nasik to	...	...	1,180	square miles.
" Nagar to	...	...	780	"
" Poona to	...	...	630	"
" Satara to	...	...	650	"
" Sholapur to	...	...	230	"

giving a total of about 3,470 square miles. How much of these are formed of the old unculturable revenue waste lands I am not in a position to say, but even in Sholapur the proportion is very great as compared with the lands that were, though registered as culturable, still given up to form forests, the occupants resigning or being bought out.

Curtailment of grazing abuses, and its progress.—All these lands, or as much as were in forests before the year 1878, were virtually given up for grazing, and this grazing was particularly obstructive to forest growth, as no sort of restriction was laid on the kinds of animals that might or might not graze. In the year 1878-79 a departmental order was issued to prevent sheep and goats grazing where it would harm vegetation. This was a step in the right direction. Another followed ordering those lands to be closed to grazing that were in such a state that *reboisement* could not otherwise progress. Had it been possible to follow these orders to the letter, the blanks that constitute the greater portions of the areas called forests in the Deshi talukas would present a very different aspect now to what they actually do. But there were innumerable obstructions to the carrying out of this policy, and by far the most important one was that the people would not submit, and the establishment being too weak to enforce submission, an enormous amount of destruction, both authorised and illicit, continues to this very day.

Curtailment—its extent in the Sholapur Districts.—In Sholapur even, where I can vouch for the protection being on the whole equal to that of the best in the Northern Division, great damage was done, and 25,000 acres of land were grazed over, where actually not more than one-tenth was at all fairly fit for it. But there was nothing to be done in the face of the ryots' petitions, backed by the Revenue Department.

The curtailment of grazing in the Nagar Districts.—In the Nagar Districts the facts were pitiable to a degree, the grazing extended over four out of five lakhs of acres, while sheep grazed in every reserve in proximity to which they happened to exist, and it was not until 1883-84 that the grazing area was even limited to three lakhs by progressive reduction, and the sheep excluded from all but 50,000 acres of it.

PRINCIPLES ON WHICH TO BASE CLOSING OF RESERVES TO GRAZING WHERE REBOISEMENT IS ESSENTIAL.

Out of the areas where *reboisement* is in progress the amount to be given to grazing should on no account ever exceed *one-half or one-third of the whole.* I take these figures from perhaps the greatest authority the world has ever known, *viz.*, "Hartig," and if he said it of a climate which is temperate

and moist, how much more should it apply to the Deccan with its tropical climate.

Locale of the various pasture lands.—The positions of the forest grazing lands vary according to the talukas in which they are found. In all those bordering on the ghats and their spurs, they lie as a general rule on the slopes of the hills. In the more eastern talukas, which contain low ranges of hills, these grazing lands are for the greater part on the slopes of the spurs. But in the talukas of the plains, such as we find in Sholapur and Ahmednagar, they are to be found anywhere and everywhere from the lowest river bed to the highest part of the watershed.

The pasture on the ghats and plains.—On the ghats the fodder consists of such grass as is found growing in the shade of the evergreen forests, lower down the grass exists in the scrub and teak jungles, and finally in the plains it exists on the "mals," or downs, and in the babúl "kurans," or meadows.

Quality of fodder. The quality of the fodder in these grazing tracts may be ranked according to the locality as follows :—

1st. Babúl kurans, or meadows.
2nd. Culturable lands in the plain.
3rd. The ghat tracts.
4th. The hill tracts below the higher ghats.
5th. The unculturable "mals."

When I say that this is the order of their quality, I refer to them all when under similar treatment, for of course conservancy in one place and not in another can alter the order. Further, the reason for this order is evidently the nature of the grass that is to be found in each locality, a superabundance of the succulent grasses, such as "haryali," "shipi," &c., belonging to the babúl kurans and lower lying culturable lands of the plains, whereas on the neighbouring "mal" we find only the stunted "kussal."

Comparison between reserves grazed and closed, and the influence on lignified growth and revenue.—That the combined grazing and cut fodder of the Deccan forests is extremely valuable, no one is prepared to deny for an instant, the revenue from the above five districts having been 1·04 lakhs of rupees in 1882-83 on this account. But the question is, was not more than that amount of damage done to the advancement of the forest? I am strongly of opinion that the damage to regeneration in wooded and partially wooded tracts, and to *reboisement* in open tracts, was more than ten times that amount. No one can appreciate the loss from grazing to lignified vegetation in its early state until he actually closes an area of land and permits it to improve as nature designed. I have closed areas and found in the space of two years that the lignified growth had increased more than ten times. I draw especial attention here to the young babúl growing in the reserves along the railway in Sholapur. I can

positively assert that in 1879 there was not in some of the old waste lands in Madhe and Karmalla a shrub or bush to be seen that was over 2 or 3 feet high, and what shrubs there were were twisted, stunted and scattered. After two years' closing, by which about 6 pies per acre and per annum was probably lost to the revenue, a growth worth more than five times that revenue had already sprung up. Not only had the lignified vegetation thoroughly asserted itself, but the grazing had itself improved, and would pay hereafter for the above-mentioned loss, when giving it out would be compatible with a minimum of damage to the rest. This is perhaps the best example that I know of the results of "conservation," still even in the poorest soils of the hills the same thing is re-enacted in a modified form. Look, for instance, at the spontaneous appearance of some hundreds of teak saplings on the Yedshi hills (Barsi) after two or three years' closing. Now the inhabitants there told me that teak had been extinct for nearly twenty years. The Deputy Conservator of Poona gave me an instance of a most remarkable nature, from which I learnt that, after a certain number of years of closing the sale value of the grass for one year alone was equal to all that had been temporarily lost, calculating it at the rates obtained before closing, and there was besides all the lignified forest vegetation *which formed the capital of another and separate revenue.* Would that forest vegetation have been there had grazing continued on the original barren soil? Certainly not! Look at the other hills which are identically the same, and which have been grazed over. What are they like? Barren and destitute!

Is grazing compatible with reboisement?—It is very clear therefore that given a bare hill side or barren plain to convert into forest, it cannot be so converted unless grazing be stopped, no matter of what class of cattle it may be a question. It is also very clear that even in a fully wooded reserve, when regeneration is going on, or fellings for regeneration are taking place, either in coppice or high forest, cattle which feed on any of the seedlings cannot be permitted in the areas over which fellings have taken place. Nor can it be denied that in irregular forests, such as scrub jungles and babul kurans, where regeneration is taking place in various parts almost every year owing to the gaps caused by death and removal of mature trees grazing is extremely detrimental.

Necessity of permitting grazing a duty of the Forest Department.—Where then (it might be asked) is grazing permissible in forests without damage? Absolutely without damage nowhere, and at no time can grazing be permitted. The very fact of large herds of animals passing over the soil does harm to it, though the trees are high and apparently out of danger. This harm re-acts on the trees imperceptibly, and as it is a loss of timber growth that takes place, and not an actual deterioration of existing timber, little notice is taken of it.

Also in estimating the damage people are too apt to be carried away by the results of observations made on one occasion when cattle are in a reserve. The observation lasts over five or ten minutes, and being small it is imagined that no harm is possible. That this is a very erroneous way of looking at the matter is evident, for a simple mathematical calculation in multiplication would show that if one seedling was destroyed in 5 minutes by the herd or drove, there would be just 100 in a day of 8⅓ hours grazing? What would be the damage in six months? I feel convinced it would be more than ten times the revenue from grazing.

Duties of the Forest Department in respect of grazing allotments.

Still as grazing for a long time to come must be permitted within forests, it behoves the Forest Department to point out (i), the areas that will suffer the least; (ii), to fix the time of year when the grazing will do the least harm; and (iii), to determine the best rules for the grazing contracts that the circumstances permit of.

Areas that may be given for grazing with a minimum of harm.—Now for the first duty we have to take into consideration the fact that in the Deccan there are certain lands on which the privilege of grazing exists. I will say nothing further regarding these lands than that they must be grazed all through the year, and by all the village cattle there is no help for it, and the Forest Department will put these down in the first place. Then comes a nature of land which is largely represented in the Nagar Districts, *viz.*, lands which from their situation, locality &c., are not and will never be of any use to the Forest Department. These lands can be at once added unhesitatingly to the devouring elements. Then we must fall back on the lands that are, can be, or should be, forests, and in which no rights or privileges exist with respect to grazing.

Classification of the forests in which grazing needs curtailment.—These lands should be divided into the following classes:—

(*a*). Old forests thoroughly installed, and which cannot, owing to their locality, be worked.

(*b*). Old forests thoroughly installed, and which are being worked annually or at certain fixed periods.

(*c*). Old forests partially denuded, and which are being relieved of their older and mature trees before decay, in order to ensure the receipt of their value at the most profitable moment.

(*d*). Lands under *reboisement* in which the superior (timber) vegetation has not as yet passed the height of the scrub.

(*e*). The same where the superior growth has passed the height of the scrub.

(*f*). Absolutely bare or sparsely scrub covered lands.

The unworkable but complete forest, nature and extent of the grazing it can support.—Now in none of these six classes can sheep or goats be permitted at any time. Any one who knows the Deccan, knows that class (*a*) are the forests that one finds all along the ghats in the region of heavy rain. Here the Forest Department may safely give up the whole area to the bovine species only. Their number when compared to the area is so very small, that the damage done may be said to be at its minimum, and I would lay no restriction to the period, but give it all the year round, except when bamboos and karvi have seeded and are about to germinate. The localities where these species are found should then be rigorously closed.

Workable and complete forests, the extent of the grazing permissible.—In class (*b*) we see examples in such of the ghat forests as are worked, *e. g.*, Mahabaleshvar (Satara), in those of the teak region where the jungle and underwood has not been destroyed, and in our babúl kurans. It depends here greatly whether the working at the time consists of thinnings or of fellings. If the former, then I see a minimum of harm in permitting the bovine species to graze. If the latter, then for 2 years previous, and from 3 to 5 years subsequently to the working, there should be no grazing. The closing need never exceed 8 or 10 years in the ghats, 5 to 6 in the teak, or 6 to 8 in the babúl kuran. In other words, if we allowed 80 years for a revolution on the ghats, we should never close less than $\frac{1}{10}$th in any one year, or 8 sub-compartments out of 80. In the teak coppice 5 to 6 years closing in a revolution of 30 years shows that not less than $\frac{1}{6}$th of the whole is closed. In the babúl forests, taking 60 years as the revolution, because that is a fair limit to the age of the babúl, and supposing the babúl forest worked by rotation compartments, we should have to close six compartments, or $\frac{1}{10}$th at least. What generally happens is that the babúl forest is worked on the selection system, and that the whole kuran or forest has to be closed when the trees are for the most part past maturity, in order to ensure complete regeneration before the old trees are entirely cleared away. Strict closing for 6 years, while the last of the old trees are being removed by degrees each year, and 2 years closing subsequent to the removal of the last reserve, is quite sufficient. These restrictions in class (*b*) will never be found to inconvenience the people, as in the localities of these forests large and extensive means of feeding cattle always exist.

Class (*c*), *its grazing capabilities.*—In class (*c*) we have examples in the second-rate teak coppice reserves, babúl kurans and dhanda fuel reserves as found in Satara and Nagar. I consider the period of closing here should be double that of class (*b*), but the increase should be before, not after, any felling. For

the Forester wants to insure an increase in the younger growth, and this can only be done before, and not after, the removal of the existing seed givers. I therefore would close ⅓rd of the whole area of second-rate teak coppice, second-rate babúl ⅓th, and dhanda fuel scrub, &c. If this is found to interfere with the wants of the people, which it probably will not, then care should be taken to see if no adjoining reserve is available. For these areas can not and must not be given, as on them depends generally ⅘ths of the revenue from timber, &c., and the continuation of the yearly supply of fuel and timber.

Capabilities of class (d) for grazing.—In class (*d*) there should be no grazing at all if possible, for here we have arrived at the ticklish moment of "to be or not to be." It will however be found next to impossible in practice to enforce absolute closing, and judging from my own experience, I think that it will be found that very nearly ⅓rd will be required for grazing, but less than ⅔rds should not be closed. For some lands similar to class (*f*) will be sure to be available, and better give them for a certain time and ensure the rapid approaching success of class (*d*), and then afterwards turn all our forces on the more barren lands.

Capabilities of class (e).—Class (*e*) should be always closed to half its area at least, and all if possible, but entire closing being impossible, it is better to sacrifice this class to the advantage of all the others excepting (*f*), always taking care not to *exceed half the total area.*

Capabilities of class (f).—Now with reference to the class (*f*), that is entirely bare lands, it will be necessary to consider all the other classes first. Now in closing any of the classes (*a*), (*b*) or (*c*), the periods of closing can be fixed, as they depend on the working of the forest. But in classes (*d*), (*e*) and (*f*) this is not the case, once a piece of land such as these is closed it must be kept so until it is thoroughly reboised and able to take care of itself. It will not do to go skipping about from one block to another, for the results will be nil, as young growth is more easily destroyed than old. Therefore close all (*f*) if you can, but if you can not, sacrifice it readily for any of the other classes.

Variation of the closed areas according to Districts.—Of course it would be difficult to state what amount of land could be closed on the average in any one district on these principles. The amount depends entirely on the kind and quantity of each class of forest existing in the district. In Sholapur the classes (*d*) and (*f*) predominate to such an extent, that it is a matter of paramount and absolute necessity to close at least ⅘ths of the whole forest area. In Ahmednagar it is as yet impossible to attain even half, and in other districts the proportion closed is probably even less.

Advantages of cutting over grazing.—Now in closing land there is one great maxim to be borne in mind, and that is to stop all grazing, that it may be possible to stop and sell the

grass if it will sell for cutting. In this last remark I fear I have entered on very disputable ground. But there is no doubt that the only disadvantage of grass cutting is summed up in the danger that the seedlings are under of being cut, and of fire being brought by the men into a reserve, where fire will, if it ignite, be fiercer and more destructive than if it occurred in a reserve which was grazed. Now the dangers of seedling cutting can be minimised by judicious treatment of the contractor, and as to the fires, the same rules will serve to keep these at a low figure. Now on the other hand, it is very clear that cattle when grazing will make no distinction about the seedlings, and the fire would be far fiercer if the grass were not cut at all. Further, there are a great many advantages from cutting out the grass, especially when it is extremely luxuriant, as the cutting gives air and light to innumerable seedlings that would otherwise be smothered, and by cutting, the damages from fire are minimised. I therefore say sell the grass for cutting for a song in the first instance, for if it pays, the people will find it out and there will be a demand for it.

Demand for fodder or cut grass.—In the Ahmednagar Districts at present there is but little demand for cut grass, except in the Nagar taluka, where $\frac{1}{7}$th of the revenue is from cut grass against $\frac{6}{7}$ths from grazing. Now as fast as the number of the better grass kurans closed increase, so will this proportion. The next revolution in forest conservancy that I await with impatience is an absolute order to sell grass for silos or cutting only in reserved forests. Cattle of the bovine species when stall-fed will improve. At present it costs a poor heifer more to go to and from the food than it can repair in the forest. Look at a hard worked bullock either at a cart or on a well. Is he not superior in every way to the cattle one sees herding in the "Deccan forests," or rather the "Deccan downs"?

Time of the year when grazing does the least harm to reserves and when it does most.—After this somewhat long digression arising from the answer to the first question, *viz.*, the duties of the Forest Department in fixing the areas to be closed or grazed, I now turn to the second question, *viz.*, to what time of the year grazing should be limited. With the exception of class (*a*), for which I have stated grazing may be allowed all the year round, I should say for the reasons I shall give below, that grazing permitted from beginning of July to end of December does the least harm to the forests and the grass, and most good to the cattle. But that grazing permitted over the months of February, March, April and May, or any portion of them, does the more harm to the forests and grass, and the less good to the cattle, as the period approaches the end of May. In June, and sometimes in July, when rain does not fall early, grazing does a certain amount of harm in class (*f*), but grazing in these months does

less harm here in these months than it does after December, and far less in all the other classes. My chief reason, and a very irrefutable one, for making the above statement is (i), what do the cattle eat during the monsoon? and (ii), what during the dry months? The answer to the first question is grass and grass only, and to the second very little if no grass, and a very large amount of the young lignified vegetation and leafy branches of older individuals.

Certain reasons for delaying grazing until end of July.—I recommend closing class (*f*) during June and July so as to permit of the grass growing strong with the monsoon showers, but I have never found it necessary or practicable on any of the other class of lands, for the people want it at once, and here the grass is invariably as strong in a month after the rain has fallen (end of June) as it will be during any portion of the monsoon.

Means of improving pastures.—I have heard it advanced that the grass should not be grazed until September so as to permit of its seeding. Putting on one side the great necessity of the grass to the people at an earlier date than this if the necessity be admitted at all, I doubt very much if by the beginning of September or end of August is the seeding time of any great number of our better grasses. The "kussal" and inferior grasses that grow in class (*f*) will seed in June and July if there be only a week's break in the monsoon. And the greater bulk of the more succulent grasses seed in November, December and even January. Keep the grass to seed! is a familiar watch-word now-a-days, *Cui bono?* Keeping grass to seed is not the best method of improving a pasture. Pasture lands are best improved by the multiplication of the roots, although throwing down seed is good. Now in India the only way to ensure this multiplication of roots is to prevent their being destroyed. During the rains grazing down the grass tends to strengthen and multiply the roots, grazing after the rains when the ground has become dry and hard tends to decrease the roots and weaken them. This is inevitable, for the animals grazing exert some traction on the root and break adhesion between spongiole and soil, which cannot be restored owing to lack of moisture. Further, those roots near the surface succumb the first, as they have no soft cushion of earth beneath them to permit of their escaping from the foot above, consequently death ensues. If there is any loss to the grass by grazing before seeding, the loss is tenfold by grazing during *the months of drought. Besides, who is not aware of the fact* that by the end of December, except on the ghats and heavier wooded hills, there is no grass left to graze, and pulling at the little short heads only intensifies the damage. Give the grass out when you like, it will be finished by December at the latest, consequently grazing in the Deccan after that is absurd. No more grass will grow as no more rain is going to fall, and as

stated above, grazing only then becomes an excuse for the cattle to turn to the succulent seedlings and shoots of young bushes or trees. Any good gained by allowing the grass to seed is lost by grazing it in the months of March, April and May. This period be it known being just when the fodder from the fields is harvested in the shape of bajri, jowari and what not other excellent food, and cattle are allowed to roam over the fields.

Periods to be fixed for each class of forest.—Consequently for class (*a*) I would say graze all the year round, for classes (*b*), (*c*), (*d*) and (*e*) from middle of July to middle of December, and for class (*f*) no grazing until the first week of August at the very earliest. It will be very hard to follow these rules strictly, as much will have to be left to the judgment of the Range executives who hold the sales, and many sales do not take place until the end of August and September, owing to various causes, such as refusal of the people to accept terms, to pay the quarter cess in advance, &c. But there is one point that should not be forgotten, and that is, never let the contract extend beyond January.

Rules under which grazing is to be given out. Turning to the last and third question, *viz.*, How should the Forest Department determine the best rules for the grazing contracts? It is very difficult to say how the grass is best sold. Some say by an open auction, others a fixed rate per 100 acres, or by the fee system of so much per head of cattle. The last no doubt pays the most in places where the grazing is extensive, and there is a proper establishment to supervise the system. But given the weak establishments of the Deccan Districts, I believe the safest and best method is to give out a contract by auction with an upset price. There is something reassuring in its publicity, that the sums bid at the auction are fair will be registered, and that Government will be paid. Nothing however in the fee system tends to an assurance that Government are not being cheated by their subordinates, or are not by their subordinates oppressing the people. Either too many or too few cattle will be found grazing in the ever-varying areas of the Deccan forests. On the other hand, in auction the greater number of the sales are held in out-of-the-way villages, and there is no possible restraint on a dishonest subordinate, unless the Divisional officer controls the prices, and sees that they attain a sum in proportion to the area and demand for grazing in that locality. By keeping an annual register of sales for each forest, a very slight knowledge of the circumstances will permit fair limits being placed on the upset price of the sale. The Divisional Forest officer can always permit immediate confirmation of important 'kurans' which fetch high prices annually, and which are invariably sold to influential and rich people at largely attended auctions.

Rates of grazing under the auction system.—In the Ahmednagar Districts babúl meadows have gone up to Rs. 13 per acre for grazing, and to Rs. 3-8 per acre for cutting. These are tip-top prices of course. In out-of-the-way places, such as the ghats, I generally sell for what the people will bid, as they cannot be expected to pay according to the area, for they have more land than they need. The Forest Department retaining the right to charge so much for every head of cattle that comes from another village.

Importance of checking the returns of sales of grass under the auction system.—There is no doubt that in the Ahmednagar Districts Government subordinates made a very good thing out of the auctions, but this arose simply from the fact that the sales were left entirely to the discretion of the Range executives, and no means instituted to check them. In 1881-82 after comparing the revenue of the Sholapur and Nagar Districts, I found that the average revenue under grazing in Sholapur was in 1881-82, Rs. 20 per 100 acres grazed, and in Nagar it was about Rs. 2-8. This state of affairs when enquired into led to a series of prosecutions for criminal breach of trust, and a great many peculiar facts were elicited. The average price per 100 acres in Ahmednagar for 1883-84 was Rs. 6. This only shows what an extremely important subject the grazing question is, and that it wants as strict attention from the Divisional officer as the sale of teak or any other important forest product. I advise the Divisional officers to compare areas given and the sums bid for every reserve, keeping a comparative statement for each year for every village, and if they do not make some very remarkable discoveries and improvements I shall be surprised.

Rates of grazing under the fee system and its chief drawbacks.—In those places where the fee system is employed, I think it necessary to state that one set of prices for even one district is entirely out of the question. In one place a fee, say of 8 annas per buffalo, would be too high, and in another far too low. What hill man would give this sum, or what man would give it even in the plains, if the extent of the forest area was only 100 acres, and the village cattle numbered 1,000 and more? Again, would it be wise for Government to take 8 annas for a season's grazing in the babúl meadows, say of Nalegaon taluka, Nagar, where 60 acres sold for Rs. 505 under the auction system? Unless, therefore, the forest areas do not permit of entering all the village cattle as grazing, under the very weak supervision that exists, it would inevitably lead to much peculation and cheating. It is hopeless to look to the persons who register their cattle to show up those who do not. The village community is so much bound together, that they would square any little differences on this point between themselves, and if necessary the forest guard.

Further objections to the fee system.—Another very great objection to the fee system is the lack of any responsibility on the part of the graziers. Under the auction system they have to pay for all damage done to the reserves. Unless they point out the offender, they have to repair the boundary marks and fences every year. Now this means an enormous outlay in extra establishments and labourers if it is to be done by the Forest Department. Under the fee system no one would, or could, be brought to do this work, for scores of people being permitted to take passes there would be no limit to the trouble to get a single boundary mark put in order, and offences in the jungle, which are kept down by the moral prestige of the contractor, would become rampant. It is all very well to say that the people would be told that no grazing would be given if offences occurred, but this is the old system of shutting the stable door when the horse has gone, to say nothing of the offences never being brought to light in many cases.

Auction sales how they should be held.—The fee system requires such an amount of elaboration in the Deccan, that I for the present advocate the auction system with an upset price for such auctions where competition is not possible. Every sale should be most formal, having its own "Lilao Kerda" and "Lilao Shert." They should be drawn up by the Divisional officer in such way as to permit the contractor no loophole to escape payment for grazing and damages, under pain of stopping grazing and impounding all his cattle if they came to the reserve. These two documents should be printed and stamped, and every publicity given of the sale. In cases where there was any doubt as to the contractors keeping the terms of the agreement, the Range executive should be authorised to compel the contractors to give a bond on properly stamped paper before he obtained delivery, as well as to find security for such sums that were to be paid within a fixed period. I consider that all contracts under Rs. 50 should be paid up at once. Over that sum and up to Rs. 200, Rs. 50 at once, and the rest within two months. Over Rs. 200, 25 per cent. down, and the rest within two months. The system of Patils and Culkarnies collecting the money is entirely unnecessary, but if properly carried out has no especial drawbacks except that it is very expensive. This system of sale has worked very well during the last two years in Nagar, and the reserves have been much better protected than they ever were formerly.

THE REAL SOURCES OF FODDER FOR CATTLE.

It now appears incumbent on me to point out how it can be proved that the forest grazing may be closed for *reboisement* without detriment to the people. Each officer can procure the statistics for his districts. I am, I regret to say, only in

possession of those of Nagar, but they will serve no doubt as an example of similarly situated districts.

	The area of Nagar is	6,650	square miles.
	The area of forest	780	" "
	The area of Revenue lands	5,870	" "
(1).	The unculturable waste excluding forests is 17·5 per cent. of the whole district, or	1,100	" "
(2).	The culturable land lying fallow is on an average 7·17 per cent. of the district, ...	480	" "
(3).	Of the culturable land in occupation the amount considered as unculturable is on the average 14·61 per cent. of each holding, or 9·6 per cent. of the whole district, or	630	" "
	Total, ...	2,210	" "

Proportion of fodder inside and outside forest reserves.—Now is it not clear that if the 780 square miles of forest be closed to the extent of even half or all, then the remaining area fit for grazing purposes is proportionately so great that if it alone existed, the loss from forest grazing being closed would become inappreciable. Some might assert it was cutting the allowance very fine, but I ask, does any one imagine that the above grazing represents the entire food for one year that all the cattle are to get? Nothing of the kind, for more than 75 per cent. of the actual weight of fodder eaten by the cattle of the districts comes from the remaining 3,660 square miles which is actually under crops of jowari, bajri, rice, wheat, &c. Compare the fodder from a single acre of jowari with that of grass taken from a forest reserve, and it will leave a sufficient margin to base the inevitable conclusion, that the grass in 780 square miles out of 6,650 square miles goes for nothing when compared with the whole possible yield of cattle fodder in such a district. For the above figures I am indebted to Mr. J. Banies, C.S.; they were, I believe, taken after the famine, but though a great portion of the waste has since been very probably brought under cultivation, it only tends to strengthen my argument, because cultivated lands on the whole produce more fodder than forest lands.

Suggestion for installation of fixed pasture lands outside forest limits.—Finally, I wish to offer a solution to this very vexed question of grazing in the Deccan, the necessity of which I am perfectly acquainted with. That large areas of land are needed to support the cattle when it is not convenient to have them in or near cultivated fields is an incontestable fact. Would

it not, therefore, be far better to have these areas defined once and for all from forests? Let them be managed by any Department that Government might decide on. There are thousands of square miles in the Deccan entirely unfit for cultivation or forests, which might be demarcated and blocked much in the same manner as forests are. A very large quantity of this land could be taken from so-called forest reserves, which never have, and never will be, covered with forests. Unless this be done, I see no chance for *reboisement* in the bare parts of the Deccan, where not three years pass but closed reserves have to be thrown open, first for one cause and then another, putting all possibility of making a forest back to the starting point, simply because there happen to be a few bushes and shrubs that the cattle can eat in these places, while grass and other fodder has run short elsewhere.

AHMEDNAGAR: R. A. F.
1st November, 1884.

SOUTH AFRICAN INDUSTRIAL EXHIBITION.

(*Concluded from page 103*).

27. *Myrsine Mehanophleos* (R. Br.)—Beukenwood.

Exhibits: 1 round block, 2 small planks, 1 square log (on wagon), 1 veneer.

A tree from 20 to 25 feet high, and from 12 to 18 inches in diameter. Bark whitish. The crown does not spread more than 12 feet. The trunk is usually single, perfectly cylindrical, quite straight, without branches for rather more than half its height. The wood is of a glossy pale-yellow colour, with waves of a transparent and slightly darker colour transversely, medullary rays well developed, showing as small brown lines resembling beech; hence its name, Cape Beech. It is said not to split or warp, and is used for wagon-work.

In the Amatolas it occurs as a small tree usually on the edge of the forest.

It is a handsome tree, with leaves resembling laurel, rather scarce.

Weight of a cubic foot, 47 lbs. Flowers in October.

28. *Nuxia floribunda* (Benth)—Vlier.

Exhibits: 1 small plank, 1 round block, 1 veneer.

A tree from 20 to 25 feet high, and from 12 to 18 inches in diameter. Bark whitish.

The timber seems to be disliked except for fellies. It appears very liable to split from the centre outwards, and does not possess any quality of beauty; though as a tree, with its fine large leaves, it is very handsome.

It is generally found growing in clusters of five or six together, and those clusters may most frequently be found on the summit of a ridge. The roots are frequently exposed for a considerable distance above ground.

Weight of a cubic foot, 47·168. Flowers in May and June.

29. Gonioma Kamassi (E. Meyer) -Kamassiwood.

Exhibits: 1 veneer, 1 plank 16 inches long, bark.

A tree from 16 to 20 feet high, and from 10 to 12 inches in diameter. Bark yellowish-grey; rough wood; very hard; close-grained; resembling box.

Is used in engraving and for the manufacture of tool handles, table and chair legs, as it turns well. It is said to be of not much value for out-door purposes.

This tree, whose flowers fill the atmosphere with their delightful smell, is plentiful in the Knysna.

Flowers in October. Weight of a cubic foot, 58 lbs.

30. Euclea undulata (Thbg.)—Quar.

Exhibits: 1 round block, 1 small plank, 1 veneer.

A tree from 20 to 25 feet high, and about 1 foot in diameter, and a crown of about 20 feet in diameter.

Resembles hard pear. Wood very hard and heavy, close-grained, and tough. The heart is of a deep brown colour; the sap-wood of a lighter brown; but both beautifully marked transversely with ripples. The proportion of sap-wood to diameter is about one-third. Fairly plentiful, but grows gnarled and crooked. Trees over 15 inches in diameter are generally rotten at the heart, but the remaining wood is still serviceable.

It is never used for carpentry purposes, but it is believed by one of the Inspectors of the Forests, to be one of the best woods the Colony possesses, apparently neither warping nor splitting.

Weight of a cubic foot 63 lbs.

31. Rhus Thunbergii (Hook)—Klip Els.

Exhibit: 1 plank 18 inches long.

32. Royena lucida (Thurb)—Swartbast.

Exhibit: 1 plank 18 inches long.

33. Fatherland's Rooiwood.

Exhibit: 1 plank 3 feet long.

A tree from 20 to 25 feet high, and from 1 to 2 feet in diameter. Wood resembling mahogany; easily worked. Is used in wood engraving.

33 (bis). Ochna arborea (Burchell)—Rooihout.

Exhibit: 1 pole.

This pretty and fairly abundant little tree, with an average mature diameter of 8 inches, often runs up to 40 feet in height.

The crown is but 5 or 6 feet in diameter, and the leaves are few in number. The bark is of a reddish colour, with blotches of white, and feels almost as smooth to the hand as if it had been polished. The bark is almost one-eighth of an inch in thickness. The sap-wood is indistinguishable from the heart, as its prevailing reddish colour deepens gradually towards the centre. It is very hard, and of immense strength, but being quite straight in the grain, it admits of being beautifully worked. It is a most excellent wood for turning and engraving purposes, and is useful whenever great strength is required without great size. It never warps nor splits.

Poles cut from it are said to be almost indestructible. The trunk is usually cylindrical, though not very straight when full grown.

Flowers in September and October. Weight, 65·168.

34. *Protea grandiflora* (Lin.)—Terblantzwood.

Exhibits : 1 plank (5 feet), 1 veneer.

A tree from 30 to 40 feet high, and from 3 to * feet in diameter. Bark wrinkled, black ; wood of a reddish-yellow colour, very hard and heavy. Little known.

Only a few specimens of these trees are found in the forests of George and Knysna.

34 (tr). *Phoberos Ecklonii* (W. Arnott)—Red Pear.

Exhibit : 1 veneer.

A tree from 30 to 35 feet high, and from 2 to 3 feet in diameter. Bark black, chinky ; wood hard, heavy, and close-grained. It takes a fine polish. Is used in wagon making.

Exhibits : 2 planks 3 feet long.

Third Group : Eastern Region.

35. *Pteroxylon utile* (E. and Z.) Sneezewood.

Exhibits : 5 planks (3 feet), 1 block.

Sneezewood is perhaps the most valuable tree in South African forests, and it is one of the most durable woods in the world, ranking in this respect equally with Jarrah and Green Heart. The actual durability of the wood is unknown. As fencing posts, it has been used since Natal and the eastern portion of the Cape Colony has been colonized. Fencing posts used on the oldest farms remain quite sound to the present day. In speaking of Sneezewood posts and poles, it is of course necessary to distinguish the heart-wood from the sap-wood, the latter being no more durable than the heart-wood of any other tree. Thus telegraph poles made of young Sneezewood sap-wood have been found to fail in a few years. Specimens of

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* Omitted in original—[ED.]

Sneezewood heart-wood have been sent to the Edinburgh Exhibition quite sound at the present day, and cut from marine piles that have been 20 years under sea-water, and partially immersed.

Sneezewood is untouched by the tropical white ant and the marine-borers, which play such havoc with many woods.

The habitat of Sneezewood is the east of the colony and Natal, from sea level up to elevations in the Amatolas of 4,500 feet. It is stated to exhibit its best growth in the moist climate of Natal. In the Cape Colony it is most abundant in the eastern coast forests, but the largest trees are found in the mountains, where it attains dimensions of 3 feet in diameter and 60 feet in height. The natural reproduction of Sneezewood is usually abundant, especially in the coast forests. But in all the forests Sneezewood seedlings suffer severely from dew, which is especially injurious to the aromatic taste of its young leaves.

Sneezewood has a small crown and light covert, with white bark resembling that of black ironwood. In the mountains it loses its leaves in the winter, and in the climate of the eastern coast the foliage becomes scanty. The seed of Sneezewood is small and winged, like many of the pines. It is somewhat difficult to collect and preserve, as it is ripe at mid-summer, a time of the year when it is exposed alternately to scorching-laid winds and heavy rain. Sneezewood takes an excellent polish, and planks showing a beautiful mottled curled grain, resembling of satin wood, have been cut from old blocks of Sneezewood. Sneezewood is not adapted for framing, on account of the facility with which it splits; but this facility of splitting is of great service for the use to which Sneezewood is commonly put—the split-poles for fencing. Cut poles of Sneezewood are not recommended, for the reason that, when young, the proportion of heart in a pole is very small, while when old the contrary takes place.

36. *Buddleia Salviæfolia* (Lamk)—Saliehout.

Exhibits: 4 planks (3 feet long), 1 block.

37. *Celastrus buxifolius* (Lime)—Boxwood.

Exhibits: 2 planks 3 feet long.

38. *Vepris Lanceolata* (a Jous)—White Ironwood.

Exhibits: 2 blocks.

39. *Olea Vurrucosa* (Link)—Olivewood.

Exhibits: 2 planks (3 feet long), 2 blocks.

40. *Harpephyllum Caffrum* (Burch)—Kafir Plum.

Exhibits: 2 planks (3 feet long), 2 blocks.

41. *Euclea lanceolata* (E. Meyer)—Bush Guari.

Exhibits: 2 blocks.

42. *Sideroxylon inerme* (Linn.)—Milkwood.

A tree from 15 to 20 feet high, and from 1 to 1½ feet in diameter. Bark dark grey, scraggy, milky inside. Wood whitish, hard and heavy, close-grained. Being very durable, it is much used in boat-building, for telegraph poles, and for posts, lasting an indefinite period in the ground. Found principally along the coast, but growing in the Amatolas up to 4,000 feet. Is comparatively scarce. Flowers in December and June.

42 (*bis*). *Bomvana* (East London).

Exhibits: 2 planks 3 feet long.

43. *Welwitschia mirabilis* (W. K. Gil).

A *Gnetaceous Angiosperm* from S. W. Africa. Welwitschia, the most remarkable of ligneous plants, grows in the waterless plains near Walwich Bay and Mossamedes, on the W. African coast, south of Cape Negro. The dwarfed, top-shaped trunk is buried in the soil, the flattened apex only being visible. From the ridged margin protrude two enormous flat leaves about 6 feet in length, and of leathery texture. These are soon beaten into shreds by the violent winds causing them to flap against the ground, and are never renewed. In the axils of the leaves arise numerous forked peduncles bearing yellowish-red four-ranked cones somewhat resembling those of bycad.

Numerous figures illustrating the general appearance and anatomy of Welwitschia are given in Sir J. D. Hooker's Memoir in the Transactions of the Linean Society, XXIV. 1, 48 to 1 XIV. Contributed by the Cape Government Herbarium.

44. *Vitis capensis*—Wild Grapes.

Exhibit: 1 jar (grapes and leaves, in spirits).

SECTION VIII.

Fancy Woodwork, including Veneers.

Exhibits: 2 stands, made by Messrs. Compton Brothers, of Fatherland's Rooiwood and Stinkwood.

CLASS I.—SECTION IV.

Exhibit: Model of a Cape timber wagon, one-sixth of ordinary size.

To colonists this conveyance is absolutely indispensable, and is in almost universal use, its peculiar and, at the same time, simple construction rendering it well adapted for transport of heavy loads on bad roads, and over countries where there are no roads—through "kloofs" and ravines where no other vehicle could possibly pass. To the former it is essential, and is utilized by him for every purpose for which Europeans use carts, cars, and carriages—from the transport of the bricks for his new dwelling to the conveyance of his family to church on Sunday;

from the gaily-bedecked vehicle which convey the bride and bridegroom on their pleasure tour to the dismal services of a family hearse.

The model above-mentioned represents a timber wagon laden with timber, as it might be seen any day outside of the "bush," but for different purposes little alterations are sometimes necessary. For transport of passengers, for instance, a tent is rigged up, and performs the service of a sun-shade during the day, and a sleeping compartment by night. Under these conditions, a wagon fulfils all the requirements for travelling, transport, and migration on land which a ship fulfils on the sea. For transport of merchandise merely a flooring of rough planks, with side-boards to keep the goods from slipping on to the wheels, or falling from the wagon.

Attempts have been made to introduce wagons of American construction, but with signal failure, the vehicles falling to pieces generally after the lapse of a few months. They have nothing to recommend them but their cheapness, and are totally unfit for "transport-riding" in South Africa, particularly over the hot Karroo country.

Wagons are generally constructed during the hottest season, and are then little likely to become shaky when extreme droughts set in.

The ordinary load for one of these wagons (long wagons they are termed when used for transport of timber) is 10,000 lbs., and the quantity of timber on this model represents 100 cubic feet. Generally drawn by 16 oxen.

Parts of wagon constructed by Messrs. Hepburn Bros., Knysna:—No. 1, nave; 2, schamel; 3, axle bed; 4, "drei" board (draai); 5, break-arm; 6, after-tongue; 7, fore-tongue; 8, break; 9, felloe (fore); 10, felloe (after); 11, spoke (fore); 12, spoke (after); 13, long-wagon; 14, Disselboom.

CLASS VI.

Forest Literature History.

I.—Reports and Pamphlets.

Exhibits:—1. *Forest Regulations:* Regulations of 1875, Regulations of 1883 (English and Dutch text); 2. Report of Superintendent of Woods and Forests (1881-2); 3. Report of Superintendent of Woods and Forests (1882-3), with working plan according to New Regulations; 4. Report of Superintendent of Woods and Forests (1883-4); 5. Practical Hints on Tree-planting, by J. Storr Lister; 6. "Notice sur les Dunes de la Coubre" (France).

II.—Maps.

Exhibits:—7. Map showing annual rainfall; 8. Map showing annual rainfall of winter months; 9. Map showing annual

rainfall of summer; 10. Number of days on which rain fell (average).

The map showing the annual rainfall is divided into zones of tints, graduated according to the quantity of rain received. The first zone, tinted very light blue, is limited by the curve passing through localities which receive a fall of 10 inches of rain annually. And this zone embraces all parts of the country which receive *less* than 10 inches annually. The second zone, tinted a deeper shade of blue, lies between the curve indicating localities which receive 10 inches of rain, and those which receive 20 inches. The third is tinted a darker blue than the foregoing, lies between the curves indicating localities which receive 20 inches and those which receive 30 inches of rain, and so on. The charts of winter and summer rains are constructed in a similar manner, but with curves (drawn at intervals of every 5 inches) indicating every difference of 5 inches in the annual rainfall registered. Winter is considered to extend over the period between the 1st April and the 30th September, and summer between the 1st October and the 31st March. In this fourth chart is written, in *blue* ink opposite each station, the number of days during which rain has fallen in winter, and in *red* ink the number of days during which rain has fallen in summer. These figures are the mean of registered returns. For some localities the observations extend over a period of six or seven years or more, and for others they are more recently collected. The green patches indicate the regions in which the forests lie, but in maps on so small a scale it has been impossible to mark the forests with rigorous exactitude, or to accurately determine their position. The documents collected at the present time suffice to give only a general idea on this account.

III.—Manuscripts.

Exhibits: Entomological Notes, by Professor Peringuey; Tables for calculating the value of standing trees and squared logs, by Cte. de Vasselot.

The calculating tables contain:—*1st.* Cylindrical volumes, calculated in cubic feet and hundredths, can be used in connection with the reducing factor under all circumstances. They are susceptible of giving as close an approximation as is ever required in scientific experiments and research.

2nd. The tables of tapering volumes, calculated in cubic feet for different decreases and different lengths, quickly give results, almost always sufficient for estimating the contents of standing trees.

They are recommended for use when a large quantity of timber has to be marked and prepared for sale.

3rd. The tables give the volume in cubic feet and hundredths for logs of different lengths, with either square or rectangular bas[illegible]

INDIAN RAIYATS AND THE VILLAGE COMMUNITY.

In your November Number a letter was written by A. W. P., in the hopes of throwing some light on "the difficult problem of the regulation of cattle grazing" by a discussion in your paper. I thought at the time of reading his letter, and the very pertinent remarks that it contained, that I would add a rider to my own somewhat lengthy treatise on the "Deccan Pasture," which if it has not met the fate it merits in your waste paper basket, may be of some use to A. W. P. I did not, however, add anything to that treatise, as I felt sure that some one would certainly have given your paper their ideas before this. Now that the February Number has appeared, and still no one writes, I have done so, as it is a subject in which I take a very great interest.

With reference to the first question, *viz.*, was there an original arrangement for each village before British rule by which its own tract of forest was preserved as source of wood for fuel and other domestic purposes besides grazing, &c.? Now I should say that no such arrangements ever existed, or we should certainly have seen it recorded by such officers as Grant-Duff, Francis, those of the Inam Commission, and authors of the village communities. In the first revenue reports for Satara and other Deccan Districts bordering on the Western Ghâts with their immense forests, no mention is made of any communal system of forest protection. Whilst looking up the records of a Native State in the Konkan with the Kharbari, for the purpose of discovering what rules existed regarding forest lands, we did not find any that could lead us to imagine that communal forests existed in the past, or anything that had even a semblance to them. What did exist, and of which there is ample proof both in the Deccan and Konkan District records of English origin and the older native ones, was a keen appreciation of the value of timber and other forest produce. That this was so may be gleaned from the royalty on trees. Looking at old Sanads granted by the Peishwas, I find that only in very special cases was the right to forest produce as timber, &c., alienated from the crown. Does not this show that under governments anterior to British that the Government was supposed to be the proprietor of all forests, and of certain trees even that were not in forests? Of course lax supervision may have existed, but that the then government farmers or collectors of revenue exacted heavy mail on the forest produce goes without saying, and I therefore certainly agree with A. W. P. that the forests in certain places were preserved owing rather to the fact that the population was more sparse and tenure of property less secure than at present. The rulers of the land who were proprietors

of the forest of course, did not object to the clearing of jungle for cultivation, as it paid them, still they never admitted the right of a commune to any forest produce beyond the free pastures of our present "mufat" lands, which are very limited in area.

The above necessarily entails my saying to A. W. P. that there were no restrictions against people cultivating or grazing in forests, provided they paid their way under the native regimé. Now it appears that even this restriction was removed under the British rule, and a premium put on the destruction of forest tracts. I know of several cases of forests having been thus destroyed under the British rule, that had been fairly well preserved under the Native. That this protection arose from any foresight on the part of the Native governments I am not ready to admit, but it was one source of protection.

I saw the statement once made in an administration report that a man lost his hand if he cut a teak tree under Native rule, that this remark was true for the forests where the Angrias held sway I firmly believe, as I have heard the same on good authority, but then this punishment referred to large trees fit for ship building. Probably the rajahs of old took similar precautions to ensure getting timber for building their palaces, for get timber they did, and of a size that one scarcely ever sees in the same place now-a-days. Sir William Wedderburn with all his love and keen appreciation of the Native's good qualities, can never make me believe that the old Native governments were patterns of peace, wiseness and moderation, with local self-government boards to look after the forests in each village.

A. W. P. is right when he thinks that there were pieces of land outside the limits of a village. They exist to this very day, and there are many such pieces in the Deccan. They have of course under our present orderly government been constituted lands belonging to no particular village, and generally go under the name best suited to the locality, with the prefix or affix of "sheri." The derivation of this term I do not know for certain, but I have been given to understand that it refers to "dispute." It merely means that these lands, some of which are entire forests, belonged to no village at all, and that when pressure of cultivation in their neighbourhoods gave them a local value for grazing, &c., several adjoining villages began to wrangle for them. This would tend to show that previous to the wrangling village boundaries were not coterminous at any rate in the locality of these lands.

A. W. P. says he has not seen Mr. Lee Warner's paper "Persecution on the Western Ghâts." I read it some months after it had appeared; no one seems to have taken much notice of it. It was certainly beneath contempt, for a more offensive pamphlet written by an officer in government service I never had the misfortune to read. It treated on a subject of which the

author was piteously ignorant, when he broached the scientific points of kumri cultivation.

A. W. P.'s remarks regarding free permits need none from me. Forest officers know that every word he says on the subject only makes them see more clearly that the proper person to issue free grants is the forest officer, and not, as remarked in the last Bombay Administration Report, by the Conservator of Forests, N. C., "an official who wishes to gain cheap popularity by giving away property for which another is responsible."

A. W. P. asks what are the best regulations for managing grazing? I have given my opinion, based on an experience of only seven years, it is true, in the pamphlet on Deccan Pastures, and I therein advocate contracts for places where forests are large and supervision inadequate. Given a strong protective establishment of say one beat guard to every 4 square miles, then the fee system will be found infinitely more paying and more easily controlled perhaps than the grazing under the contract system is. Now registering by branding and marking cattle is out of the question. Just fancy the work! For each year a new brand would have to be made, poor brutes! A buffalo of 10 years standing would look a sorry sight. I have some three lakhs of grazing in my present Division, and I think that about six lakhs of cattle graze on it. What would be the cost of branding these animals? I strongly recommend Divisional Officers to make the Range officials issue printed passes to each man desiring to graze his cattle, with the number and kind entered thereon, and on the back of the pass an intimation should be printed to the effect that the person who tends the cattle must carry the pass on him. The Divisional Forest Officer has plenty of chances of dropping down on the grazier, let him then count the cattle and examine the pass. If anything is wrong the Divisional Forest Officer knows what to do, if he does not, he is not worth his pay. One or two good examples that make all involved smart will very soon produce the desired effect, *viz.*, that of Government of the present day protecting its forests and its grazing as of yore without the aid of any village communes.

NAGAR,
27th February, 1885.

R. A. FAGAN.

XMAS. IN SOUTH AFRICA.

THE following cutting from a King William's Town newspaper will, I think, interest readers of the 'Forester,' the more so perhaps as it will arrive at the beginning of the Indian hot weather. People in these southern colonies hanging on to tropical continents have a wonderful capacity for bearing heat! One has read about it in Australia. Europeans in India do not

walk to Church in correct British clothes, with the sun at 170°, and the air at 116°, sit in this temperature for two hours, and then walk home and enjoy dinner. Punkahs and pith hats are unknown, and sunstroke rarer than in England, and all this in a country lying in the same latitude as extra-tropical India, say India between Calcutta and Simla. The Australians may with truth speak of their climate as a type apart from anything in the northern hemisphere. And the salient feature of this type, I believe its healthy feature, is its changefulness, eradicating the weak, strengthening the strong. Hot winds from the interior are invariably followed by cold air, and probably rain from the Southern Ocean. The year progresses with comparatively little difference between summer and winter,—a hot sun when it does not rain by day, cool airs or biting cold at night.

On this first Sunday after Xmas. I was travelling in the postcart between Grahamstown and King William's Town, and, to me, this 116° in the shade was less trying than an average hot day in Bangalore, where the thermometer never goes beyond 90° in the shade. But 90° in Bangalore means three months of nineties, a cumulative discomfort which is appaling, while 115° in South Africa means anything between 60° and 100° for tomorrow, an uncertainty which is pleasing. As I write, this wet New Year's afternoon, I notice that the thermometer stands at 45° in my tent.

KAD HANDI.

"Sunday was one of the most terrible days—if not the most terrible day—experienced here. The sun rose into a clear sky, the distant hills appearing to be covered with smoke. The thermometer soon showed 80° in the shade, and hardly a breath of air stirred. By eleven o'clock the heat was overpowering, and the air grew hotter and hotter. Those who went to the several places of worship, all seemed thankful to be dismissed, and went home through an atmosphere that was as the blast of a furnace. It seemed as if something had twisted the equator away and dropped it down in King William's Town. The heavens were festooned with heavy thunder clouds, and a storm was hourly looked for. During the afternoon the wind blew gales—first one way and then another—and the dust was carried in banks of clouds in all directions. At one time it looked as if the town was going to be buried, at another the town appeared to be going elsewhere. As the sun went down the wind moderated, but the air cooled but slightly. The evening congregations were all very small, and the heat still overpowering. About ten o'clock two or three flashes of lightning were noticed, but no storm came, and the night was hot. The temperature reached 110° in the shade at the Hospital.

"The register at the Botanic Gardens for the hottest day this year (Sunday), showed 169° in the sun as the highest reading, which was taken at two o'clock p.m. The shade maximum was 116½°, which is a degree and a half higher than any previous "reading" remembered here.

"During one day of December last year this extreme temperature was exceeded for an hour, the glass registering 172° in the forenoon.

"The *rainfall this month has been almost nothing, being only 0·22*, of which 0·14 fell yesterday. No wonder the country bears such a burnt up appearance.

"Last month the rainfall was about 2·19 inches, and it improved herbage very much for a time. But the good effect was soon lost owing to high temperature, and the prevalence of strong drying winds."

CONES OF *PINUS LONGIFOLIA.*

Now is the time, for those who are situated near forests of *Pinus longifolia*, to see the progress of the cones. I have gathered several specimens, and they are very curious; the *young cones* are appearing at the end of a leaf stem "by ones, by twos, by threes." Unlike the deodar, the male catkins are found on the same stem with the young cones. In one specimen there is first the young cone about half-an-inch long at the end of the new stem, then at the base is a young green cone some 1½ inches long by 1½ inches diameter at its thickest part. I must confess I do not understand *this* cone; it is so green and succulent that it appears to have been lately produced, but how is it so much larger than the others? On the same branch, but on last years' growth of stem, is the male flower, the pollen having fallen about a week ago. In colder elevations the pollen has not yet been shed. Another specimen has the very small cones together with a ripe cone which will shortly burst. Another has three ripe cones and two of the larger green cones. I shall watch the development in one or two marked trees.

J. C. McD.

LIGHT GRAZING IN THE BERAR FORESTS.

THE following statement shows the financial result of the scheme for light grazing introduced last rainy season into the State Reserves of the South Berar and Wun Divisions.

Sanction to the scheme was not received in time to admit of full advantage being taken of it by large cattle owners, many of whom had made other arrangements for grazing—some by sending their cattle elsewhere, others by purchasing waste lands under the Survey and Settlement Rules. The scheme has, however, been greatly appreciated, and there have been few or no difficulties in working it. It has also proved a decided success so far, and it is expected that next year the full area allotted to each head of cattle will be everywhere worked up to.

The following extract from my inspection report on the South Berar Reserves describes the appearance of the forests after they had been grazed :—

"*Light Grazing.*—I was agreeably surprised to notice the small effect that light grazing had had on the crop of grass. In most places an inexperienced person would hardly have observed that grazing had taken place at all. The grass appears to have grown almost as quickly as it was eaten, and there is still a sufficient supply left on the ground to meet all possible requirements.

"*Natural reproduction in localities lightly grazed.*—It was also a matter of satisfaction to me to notice that natural reproduction was much more plentiful in places that had been lightly grazed than in completely protected localities. This may be accounted for in great measure by cattle treading seed into the ground, and also by fewer seedlings being smothered by a rank growth of grass.

"The same result is observable in places where broad-cast sowings of teak seed have been made."

In consideration of these satisfactory results, I would now beg to recommend that light grazing be extended to the whole area of the reserves, but to further protect forest interests in case of a partial failure of the rainfall, and there not being so luxuriant a crop of grass in the reserves in consequence, the area allotted to each head of cattle should be increased from 2½ acres to 3 acres.

This year in the heaviest grazed reserves, *viz.*, Ghat Bori and Rui, where the allotment per head of cattle was 2·6 and 2·5 acres respectively, considerably more grazing might have been permitted without injury to the forests, and therefore, if the allotment is increased to 3 acres, there should, I think, be no fear of overgrazing in a year of scanty rainfall.

I would also recommend that buffaloes be excluded in addition to sheep, goats, and camels, as these animals are liable to browse on the young shoots of trees at the commencement of the rains, as well as to injure trees by rubbing against them when tormented by flies and other insects.

It will further be necessary, for obvious reasons, to strictly forbid grazing in localities where fires have occurred in the previous dry season.

Amongst other advantages which light grazing in reserves has brought about, I would mention the beneficial effect it has had on the neighbouring District forests, which do not show nearly so marked signs of being overgrazed as they did last year, and this improvement will be still more noticeable when additional cattle have been admitted into the reserves.

When the system of light grazing has been given full effect to, too, it should be possible to reduce expenditure on fire conservancy very considerably. Line burning should not cost so much, and fewer fire-path watchers should be required; and in case of accidental fires occurring, the extinguishing of them should be a matter of comparative ease.

I have every reason for hoping that the introduction of light grazing into State Forests will be the means of solving the difficult problem of how best to reconcile the interests of the ryot in the matter of grazing with those of the Forest Department in the restoration of the areas committed to its charge.

By excluding sheep, goats, buffaloes, and camels—the animals most destructive to forests—and limiting the head of other cattle permitted to graze, the Forest Department prevents all possibility of serious injury occurring to its reserves, whilst it, at the same time, confers an immense boon upon surrounding villages by providing extensive grazing for the greater portion of their cattle. The grazing too is given at the time of year when it is most valued, *viz.*, from the commencement of the rains till the end of October. After the "kharif" crops have

been reaped at the commencement of the cold weather, cattle in Berar are, as a rule, withdrawn from their grazing grounds, and fed on the stubble, &c., left in fields, supplemented by the leaves and stalks of "jowar."

When grazing for a limited number of cattle is provided in State Forests, the taking up of these areas will cease to be looked upon by the rural population as a sudden and complete reduction of their grazing grounds.

Reserve.		Area of reserve, in acres.	Area open to grazing, in acres	Number of cattle admited.	Area per head of cattle, in acres.	Revenue realized		
						Rs.	A.	P.
Gerumatergaon,	...	45,992	22,996	4,912	4·6	1,352	12	0
Ghat Bori,	...	29,235	14,617½	5,596	2·6	1,473	0	0
Amdari, ...	...	13,717	6,858½	1,469	4·6	425	8	0
Penganga,	...	11,575	5,787½	946	6	226	12	0
Rui, ...	...	6,647	3,323½	1,812	2·5	363	0	0
Kelapur, ...	...	40,747	20,373½	2,229	9	418	11	0
Gondwakri,	...	*16,359*	*8,179½*	*2,324*	*3·5*	*573*	*4*	*0*
Khorad, ...	...	16,117	8,058½	585	13·7	114	3	0
Patroat, ...	..	2,889	1,444½	337	4	73	2	0
Lonbahel,...	...	8,966	4,483	1,583	2·8	322	2	0
Anjan Kheir,	...	7,634	3,817	890	4	193	5	0
Total,	...	199,878	99,939	22,183	4·5	5,535	11	0

A. T. DRYSDALE,
Conservator of Forests, Hyderabad Assigned Districts.

Note.—Light grazing by cattle, other than sheep and goats, has been admitted for several years in some of the deodar forests of the School Circle, N.-W. Provinces, and has also been allowed since 1881, from July till the end of December, and even later in case of a substantial winter rainfall, in the Government sál forests of Dehra Dún and also recently of Saharanpur. Herds of buffaloes which graze are specially dealt with, and only graze in the open forests, and there are so few buffaloes amongst the village cattle, that no special rules on their account are needed.—[ED.]

III. Notes, Queries and Extracts.

TIMBERS OF UPPER ASSAM.

By Chevalier Roberto Paganini, *late Chief Engineer, Makúm Division, Assam Railways.*

It will be easily understood that in a country where the temperature of the plains and low hills never falls below 45 deg. F., and never rises above 100 deg. F., with an average rainfall of 120 inches a year, vegetation cannot but be of the most luxuriant character and extreme variation. In fact, one of the characteristics of Upper Assam is its interminable jungles constituted in places by thick forests of colossal trees, and in others by impenetrable cane or bamboo groves.

As a rule, cane jungle will grow in swampy ground, where water lodges for several months, and sometimes all the year round. Bamboo jungle will grow in low lands flooded occasionally, but where the water does not remain for any length of time. Forest jungle generally grows in dry soil, and one or other of any special tree seems to prevail according to the different altitude of the ground, or perhaps it would be better to say according to the different degree of moisture retained by the soil. The prevalence, however, of any special tree is by no means strikingly apparent. In spite of favourable ground, and the gregarious tendency of nearly all forest trees, it seems that a great variety will grow and flourish side by side in a way which would seem quite incongruous in our country. The only clear fact in these forests is the total absence of certain species of trees under peculiar circumstances. Thus Nahor and Makahi, as will be seen hereafter, are never found in low lands, especially if subject to occasional floods, while Uriam and Hollock are never found in high, well-drained land. However, as a rule one may stand in one of these forests surrounded by trees growing as thickly as possible, and he will find it difficult to detect half a dozen trees of one species. This fact considerably enhances the wild beauty of the Assam jungles, but it has been up to the present time a great drawback, from a mercantile point of view, to the proper utilization of the timber. For the purpose of collecting one kind of timber it necessitates going a great distance through untrodden jungle, and after having found and cut it to the smallest size, elephants are required for the purpose of dragging it off. This process, of course, causes a

large portion to be wasted, which under other circumstances would be very valuable.

The Assam Railways and Trading Company, amongst other concessions obtained from the Government of India, have the monopoly of the timber trade for 1½ miles along each side of their line, which runs from Makúm Junction to Margherita (a distance of 23 miles), and the specimens on view at the Health Exhibition come from these forests, which extend, practically, uninterruptedly from end to end of the above-mentioned portion of the line.

When the company first commenced work in opening out the country, little or nothing was known as to the real value of many of the timbers, and as the company's works depended so much on them, they had to start at the beginning, and thus acquired an amount of information which will prove very valuable for the future of the timber trade of that country.

The following is a description of the various specimens exhibited :—

Mesua ferrea.—Assamese name, Nahor ; English, Ironwood ; specific gravity, 1·23 ; co-efficient of rupture in cwt. and decimals, 27·9 ; loss of weight when chemically dried, 25 per cent.; maximum shrinkage due to above operation, 8 per cent.

There are some good patches of almost exclusively Nahor trees to be found here and there growing on high, well-drained ground, but they are not extensive. The stem is generally straight, and the average size is from 25 feet from the foot to the first branch by 5 feet girth, maximum height found 45 feet from foot to first branch, maximum girth 12 feet 6 inches. The branches are generally thin and of no use as timber, but they produce excellent charcoal and make first-class firewood.

The timber is of a deep red colour, with very close undulating fibre, rather brittle, warps and splits when cut into planks or small scantling, heartwood not attacked by insects of any kind, and stands almost indefinitely, both exposed and under cover, without deteriorating. Before being used it should be stripped of all its sapwood, and thus prepared forms an invaluable material for bridge piles, beams and thick scantling generally ; in fact, it serves almost as a substitute for cast-iron.

Artocarpus Chaplasha, Assamese name, Sam ; English, Monkey Jack ; specific gravity, 0·63 ; co-efficient of rupture as above, 12·3 ; loss of weight in chemical drying, 32 per cent.; maximum shrinkage due to above process, 5 per cent.

This tree does not seem to have a preference for any particular ground ; it grows in low land with as much vigour as upon the hills. It is never found in patches, but is liberally scattered all through the jungles. The stem is seldom very straight and branches off soon, sometimes at a few feet from the ground, but the branches often produce good timber. It is of a bright yellow colour when cut, and deepens into a brown walnut colour in the

course of time. The fibre grows pretty straight, not very close, breaks short, and receives easily a clean polish. It warps and splits very little. It stands well either exposed or under shelter, and insects will not attack it. It is a very useful timber for any purpose where great strength is not required, being specially adapted for household furniture, as it is equal or superior to teak for this purpose.

Bischoffia javanica.—Assam name, Uriam; English none; specific gravity, 1·04; co-efficient of rupture as above, 15·2; loss of weight in chemical drying, 24 per cent.; maximum shrinkage due to above process, 10 per cent.

It grows abundantly, though never gregariously, along the banks of the rivers in the low plains, and preferably where *occasional* floods cover the ground. It sometimes grows straight, but not generally so. Thick branches soon divide the stem, and yield useful timber. The girth of the stem varies very much, and the timber obtained from one of 4 feet girth seems to be as good as that obtained from a 12 feet girth (which size is not uncommon). The timber is of a dark cold red colour, the fibre straight and close, and hardly recognisable; it warps and cracks under shelter, and if the place is very dry becomes very brittle. White ants will attack it. On the other hand, it is almost imperishable in wet ground or under water. This circumstance makes it particularly suited for pile foundations and railway sleepers. And for this latter purpose especially, we believe, considering the present prohibitory prices of other wooden sleepers in India, it will soon become very useful.

Terminalia myriapteron.—Assamese name, Hullock; English, unknown; specific gravity, 1·06; co-efficient of rupture, as above, 13·4; loss of weight in chemical drying, 35 per cent.; maximum shrinkage due to the above process, 2 per cent.

This tree grows under the same circumstances as the Uriam, and almost invariably where Uriam is to be found Hullock is also found; it is not so abundant as the former, but grows to a much larger size, and shows a gregarious tendency here and there. *Although branches are often to be seen starting a few* feet from above the ground, it possesses generally a long stem growing to a considerable height, and the branches yield good timber. It is frequently recognised by its towering above the surrounding trees. The stem also grows to a great thickness, 10 feet to 12 feet girth being the ordinary size, but one on being measured was found to be 21 feet girth. The timber of young trees is almost valueless, as not only is it greedily attacked by the carpenter beetle and other insects, but soon deteriorates when exposed to the climate. On the contrary, the timber of the maturer trees is excellent for many purposes, straight grained, pretty hard, of a brown colour, does not warp or split to any considerable extent, even when not seasoned, stands well in and out of doors without deteriorating. Its only enemy is a kind

of small borer, which is easily got rid of by painting it with crude petroleum or coal tar. It is peculiarly adapted for cheap furniture, windows, doors, railway carriages, and generally for any work where accurate fitting is the main object.

Dipterocarpus pilosus.—Assamese name, Hollong; English, none. No experiments have been made on this timber. It grows in high well-drained land, is not gregarious, but is pretty thickly scattered about. Its stem is very straight and attains a very large size, averaging 8 feet girth and 60 feet to 80 feet from foot to the first branch. Instances of 18 feet girth by 90 feet to the first branch are not unfrequent.

The timber is of a reddish-brown colour, close and pretty straight grain; it does not warp or split much, but quickly deteriorates unless kept in a dry and ventilated place; is attacked by nearly all timber insects. Thus, notwithstanding its large size, it is of little or no use, except for temporary purposes and for packing boxes; it must, however, be borne in mind that in Assam this latter use forms a very important business, as not less than 400,000 boxes for packing tea are used yearly, the making of each one requiring about 1·50 cubic foot of rough timber. A large quantity of such boxes are now imported from Calcutta, and the balance is made by hand-saw, and a few saw-mills, which are busily engaged exclusively in that trade all the year round.

Shorea assamica.—Assamese name, Makahi; English, none; specific gravity, 0·82; co-efficient of rupture in cwt. and decimals, 13·2; loss of weight in chemical drying, 36 per cent.; maximum shrinkage due to the above process, 5 per cent.

This tree deserves, for many reasons, more attention than any other. It is, for one thing, quite a new tree, so to speak. It was but a few years ago that Mr. G. Mann, the Conservator of Forests in Assam, took special notice of it, and studied and classified it with the devotion and care peculiar to all true naturalists.

To the best of my knowledge, it grows exclusively along the hill on the south bank of the Dehing river, forming a belt which thins out and eventually disappears as it approaches the Patkoi range to the south, and the Jaipúr (Assam) district to the west. How far it extends eastward I can not say. Not one Makahi tree is to be found north of the Dehing river. It grows to various heights, and always in well-drained ground. Its gregarious tendency forms an exception to all other Assam trees: in some places the forest is almost exclusively constituted by Makahi trees, and in all cases it grows so thick that were all the other trees to disappear there would still remain a good Makahi forest. Its stem grows perfectly straight to a height averaging 70 feet to the first branch, and a girth of 8 feet. It is not unfrequent to find some of 90 feet or even 100 feet to the first branch, and 12 to 14 feet girth. In the construction of some bridges I required fifty trees that should not measure less

than 8 feet girth at 60 feet above the ground, and I found them all within a radius of a mile from Margherita. The timber is almost white when newly cut, but soon turns to a dark yellow colour and brown if exposed to the open air. Its grain is very straight and not very close, and warps and splits when quickly dried, but not otherwise. It soon rots away in the ground or when subject to constant and abundant moisture, but stands very well under cover or in the open air as long as water cannot lodge in contact with it. White ants and borers will attack it.

Notwithstanding the lasting qualities of this timber not being very superior, we consider that at no distant date Makahi is destined to represent an important item in the timber trade of India. We may incidentally mention that its liability to rot and to be eaten by insects can be disposed of by pickling, and that this pickling has proved to be very effective when done with crude petroleum, of which there are abundant springs belonging to the Assam railways, right in the centre of these forests. But independently of that a cheap timber for general purposes, to be used as common deal is used in England, has been entirely wanted up to the present in Assam and Bengal. Bamboo is often substituted, but as often as not this does not answer, and then the expensive teak or sal is used. Makahi does not present the same difficulty as other Assam timber in felling and collecting, it is easily worked, leaves little waste on the ground, and there is such a quantity as will supply the market for many years to come. Up to the present it has been practically unknown and inaccessible. This latter difficulty has been done away with by the opening of the railway from Dibrugarh to the Makúm coalfields. The former will dispppear as fast as the advantages of this timber are recognised.

We will finally remark that, besides the trees above mentioned, there are at least a dozen more species equally good, though not so abundant. The great drawback of their growing so mixed is, in the case of the Assam railways, removed to a great extent by the peculiar feature of its timber concession, owing to which the farthest tree has never to be dragged by elephants more than 1½ miles to reach the railway.—*Timber Trades Journal.*

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A VISIT TO KUCH BEHAR, THE BHUTAN DUARS AND ASSAM.

In Vol. VII. of the "Indian Forester" will be found a short account of some plantations at Kuch Behar which I have lately re-visited, and now give some of the dimensions attained by the different species.

The species planted are teak, sál, sissú and khair, but of these sissú is the only species which appears thoroughly suited to the soil and climate of the place.

Sissú seed was sown in nurseries in 1872, and the seedlings planted out at distances of 16 feet, and although it is evident that if the distance had been less, the boles of the trees would have been straighter than they are, yet the results obtained are very good, as I measured three specimens, respectively 4 feet 2½ inches, 3 feet 7½ inches, and 3 feet 9½ inches in girth, at 4 feet from the ground, with a total height of 80 feet and averaging 50 feet of bole. When I saw these trees in 1881, the average girth was 2 feet 8 inches, and the total height 50 feet, so that the rapidity of the growth can be appreciated.

Sissú has now been planted out in a block of about 500 acres on the Kuch Behar-Mogal Haut road, and is doing well, in spite of the whole plantation having been burned this year, for sissú apparently suffers far less from forest fires than sál and many other trees. There are also avenues of fine sissú trees planted along all the roads in the State which are numerous and in good order.

I also measured some sissú trees at Tamai Haut in the Eastern Duars, 24 miles from Kuch Behar, which I had planted out myself in 1878, having taken small natural seedlings from a neighbouring island in the Gadadhar river. One of these measured 2 feet 9 inches in girth at 4 feet from the ground, and was 40 feet in height.

The soil of the town of Kuch Behar is a light colored micaceous sandy loam, and the water level in the monsoon months is only a few feet from the surface, so that building sites are

prepared by digging tanks and throwing up the earth round their banks. Such a soil is evidently not adapted for teak or sál; but besides the sissú, the sau tree, *Albizzia stipulata*, attains fine dimensions on it, in a few years.

The teak plantations were made from nurseries sown in 1874, the seedlings being planted out 6′ × 6′. I measured three of the teak poles and found girths of 2 feet, 2 feet 9 inches, and 2 feet 7½ inches, with a height of 55 feet.

Some of the trees are straight and apparently vigorous, but I doubt whether they will ever yield good marketable timber, and many of them have an unhealthy appearance and are unsound at the centre.

The sál plantation still looks flourishing, but the rate of growth is slow, the trees probably suffering from the water-logging of their roots in the monsoon months. They are from seedlings taken from the Baxa sál forest in 1874, and have now an average height of 40 feet, and three specimens measured 1 foot 8 inches, 1 foot 8½ inches, and 1 foot 10½ inches, at 4 feet from the ground.

The State Superintendent of Agriculture and Forests, Kumar Gojendra Narayan, M.R.A.C., a cousin of the Maharaja's, kindly permitted me to fell one of the poles, which are rather crowded, and on a section of the wood, it was impossible to tell the age by the rings, which were far more in number than the age of the trees would account for. They were also confused, running into one another, and only distinct for a portion of their circumference, and thus agree with Mr. Brandis' description of sál wood.

Cultivation is spreading rapidly all over the Kuch Behar State, but there appears to be little demand for forest produce, as each homestead is surrounded by mango, jack, and other trees and bamboo clumps. Small sál posts are, however, in demand for supports to the mat and bamboo houses, and a certain amount of wood must be required for boats and agricultural purposes, and for bridges and public buildings.

The most notable change which I noticed since I visited Kuch Behar in 1881, is the great extension of tobacco cultivation, which formerly was in small plots for household use, but is now largely carried on for export.

From Kuch Behar I visited Baxa, passing through the great Baxa sál forest.

The large export of railway sleepers has diminished the quantity of mature timber, but some magnificent sál trees are still standing near the Baxa road.

Inferior species, such as akshi (*Dillenia pentagyna*), chilaunt (*Schima Wallichii*), sida or dhaura (*Lagerstræmia parviflora*), are encouraged by the removal of the large sál trees, and it is a pity that improvement fellings, such as we have started in the Dehra Dún forests, in which such trees are girdled over

the young sál seedlings, and afterwards exported as fuel, cannot be started.

But here there appears to be little or no market for any wood but sál, and mere girdling without subsequent removal of the trees would only increase the risk from fire. There are, however, large building works in progress at Kuch Behar, especially the magnificent palace in progress for the Maharaja, and large quantities of fuel are required for bricks, for which mango topes are probably sacrificed as in other parts of India.

It is also strange that all the lime which is being used is imported from Sylhet, though there is plenty of limestone on the Bhutan Hills, and in order to improve the forests, it would be almost worth while to grant to contractors the standing inferior trees in the forest free of charge for lime burning. It is quite possible that teak might succeed in the deep well-drained alluvial soil of the Baxa forest. Baxa is a little Military station at an altitude 2,000 feet on the lower slopes of the Bhutan Hills. It was built after the last Bhutan war to protect from Bhutea raids the Kuch Behar State, and the strip of country acquired from Bhutan termed the Duars, part of which is in the Jalpaiguri District of Bengal, and part in the Goalpara District of Assam.

The commonest indigenous tree in Baxa appears to be *Castanopsis indica*, and the hill above the station, about 6,000 feet high, is covered with a dense evergreen forest of species apparently quite distinct from those of the North-West Himalaya. There are several large caoutchouc trees (*Ficus elastica*) near the regimental parade ground.

The chilauni is very common on the slopes between Baxa and the level of the sál forest as well as on the [illegible], and large tree ferns abound on the hill sides. On leaving Baxa, I camped through the grassy plains and spreading cultivation of the Duars to Jalpaiguri. On the way we shot some florican, red and black partridges, snipe, wild duck and golden plover, and missed a leopard which killed a goat close to our camp.

Jalpaiguri, on the banks of the Tista river, is no longer a Military station, as it was for several years after the Bhutan war, but is becoming a large centre of trade, and tea cultivation has spread over a large extent of country at the foot of the hills. It is worth notice that 3,000 strawberry plants which I sent there last October from Mussoorie, have grown most vigorously, and have borne a fine crop of fruit from February to May, as the damp climate and sandy soil when well manured suits them admirably.

Here I visited a tea garden belonging to the Tundoo Tea Company, and had a day's mahsir fishing in the Jaldoka river, but only succeeded in hooking one fish. It was at this garden last year that a *must* elephant killed sixteen coolies in one day, and yet I hear that no compensation was paid to their families

by the owner, who is the most influential Zamindar in Berar, but perhaps has never rightly understood what occurred.

The tea seed for these Western Duar tea gardens is imported from Assam, and it is an important question whether tea seed is good when the testa or skin is separated from the embryo inside the shell. I referred this question to Mr. Logan of Dhubri, who for many years passed tea seed on its way from Assam, opening the boxes and testing a certain proportion of the seeds, but his opinion was that provided the embryo was all right, that the separation of the testa was not prejudicial. Mr. Peal also says that opinion is divided on this point, but does not consider it prejudicial provided the seed is fully ripe, and he has promised to test the question thoroughly by planting two lots with and without the testa.

From Jalpaiguri, I went by the Northern Bengal Railway and steamer to Dhubri, and thence by the new daily steamer service to Tezpur, the civil station of the Darrang district in Assam.

The best tea gardens in Darrang are on a plateau of forest land which approaches within 10 miles of the Brahmaputra, and except for the clearings for tea cultivations is covered with virgin forest, known as the Charduar forest, up to the Akha Hills.

A large area consists of pure forest of *Mesua ferrea*, the Assam nahor and Bengal nageswar, the timber of which might surely be utilized for railway sleepers, for which there is a large demand at present, as I hear that the creosoted Norway pine sleepers imported for one of the Bengal Railways have proved a complete failure. The jutili, *Altingia excelsa*, is another social species, and the amari, *Amoora spectabilis*, the sama, *Artocarpus Chaplasha*, the poma, *Cedrela Toona*, and the gondsoroi, *Cinnamomum glanduliferum*, also yield fine timbers and are disseminated through the forest. Whilst old tea gardens with bad jat of plant are being abandoned in parts of Darrang, the fine young gardens of high class hybrid and Assam indigenous plant on the forest plateau land, and even on grass land below it, are doing very well, even at the present low price of tea, and I hear that Rs. 0-10-6 per lb. was the best average price realised in the Darrang district for last year's crop. The dark Assam hybrid plant is now preferred as more hardy than the light-leaved indigenous. These forest gardens, on undulating plateau land surrounded by a wall of *Mesua ferrea* trees, have a singular appearance, but are said to be more healthy than the grass land gardens.

As formerly, the labor question is a great difficulty, but machines are now largely used everywhere, Davidson's Sirocco doing the work of a large range of *chulas*.

To take an example of a fine tea estate, that of the Borelli Company has 7,500 acres of fee simple forest, and uses up annually 85,000 maunds of firewood in its engines, and the wood for 4,500 boxes, each containing 18 superficial feet, or ½

cubic foot with ½-inch planking, or taking in waste in sawing, we may allow 1 cubic foot per box.

A quantity of timber is also used annually in repairs to buildings, so that perhaps we may some day hear of the large tea companies managing their forests scientifically.

Many gardens which have no private forests still purchase teak boxes in Calcutta, and pay Rs. 2-8-0 each landed at the nearest river-ghât.

I heard that the Assam Company imports 35,000 teak tea boxes annually from Calcutta.

In the Borelli Company's gardens, the steam saw was hard at work preparing wood for tea boxes. I was told that provided the wood was properly dried there was not the slightest fear of its injuring the tea, and all species which would saw well, and are not too heavy or hard, were used, the kochan (*Duabunga sonneratioides*) having the preference. On the islands and banks of the Borelli river there are nearly pure forests of this tree, which is of rapid growth, and a Marwari merchant has started a saw-mill to prepare tea boxes for the planters at the Balipara Haut, which he sells at 1 rupee each.

Mr. Lumsden, the Manager of the Borelli Company, showed me how he was gradually eradicating China plants from his gardens, by pulling them out by ropes attached to an elephant, at the rate of 200 plants per diem. Twenty acres of China plant are thus removed every year, and the ground replanted with indigenous or high class hybrid plant, and the yield thus increased from 2 or 3, to 7 or 8 maunds per acre.

The bad results of former heavy prunings were evident in the diseased stalks of the old tea, many of which were furrowed by white ants up to the top of the bush. The beneficial results on the growth of tea of the sau tree, *Albizzia stipulata*, have attracted the attention of many planters, and I saw for myself that bushes under the shade of this tree were more vigorous than their neighbours.

A small pamphlet on the subject has been published by the Indian Tea Association, in which many Assam planters give their experience on the subject, all being favorable to the sau tree.

Mr. Peal considers that all the Assam *Albizziae*, namely, *A. elata*, *stipulata*, *procera*, *odoratissima*, have the property of improving the growth of tea directly under their shade.

The sau tree has very long superficial roots and bears quantities of seed, the former may assist in draining the soil, and the pods and leaves falling on the ground may enrich it, whilst the shade is not too great to affect the production of leaf in the tea bushes.

The greatest attention is now paid to the water supplied to tea garden coolies, and their huts are far better than those of villagers in the Dún, but there is still a good deal of sickness amongst those freshly imported.

The planters are a fine healthy set of men, and play polo regularly, and the gardens are so numerous, that the old solitary life in the jungles is a thing of the past in Darrang.

It is worth noting that certain species of forest trees spring up naturally in tea gardens. In Darrang the simal has the preference, in the Western Duars it is the kadam, *Anthocephalus Cadamba*. In the Dun, it is the tún, *Cedrela Toona*.

Mr. Campbell, the Forest officer, was not at the Balipara Haut when I arrived, and I therefore visited the caoutchouc plantation with the Forester, but I subsequently met Mr. Campbell, and obtained full information from him about the plantation. About 14,000 plants have now been planted out in lines 40 feet broad and 100 feet from centre to centre, the intervening jungle being left standing to provide a moist atmosphere for the caoutchouc.

The first plants were put out by myself in the spring of 1874, and the following are the heights and girths of 50 trees measured in June 1883 :—

Heights and girths of 50 trees measured in each year's plantation since 1874-75.

Year when planted.	Average height.		Average girth.	
	ft.	in.	ft.	in.
1874-75, ...	37	8	2	6
1875-76, ...	34	5	2	1
1876-77, ...	32	3	2	1
1877-78, ...	29	5	1	9
1878-79, ...	23	4	1	1
1879-80, ...	17	5	0	10
1880-81, ...	13	8	0	8

There are about a lakh-and-a-half of seedlings in the nurseries. These are not now planted out until they are 10 feet high and beyond the reach of deer, which formerly grazed down the young transplants. Wild elephants still get in and damage the trees, but the plantation is a great success, and the cost Rs. 72,450, up to end of January 1885, is not too much for Government to pay, on an experiment to produce caoutchouc on a large scale from *Ficus elastica*.

For some time past the price of caoutchouc has been Rs. 80 a maund in Assam, but owing to the market having become overstocked, it has fallen again to about Rs. 40.

It is said that large plantations of ceara rubber are being made in South America, and this may account for the lighter demand.

The rainfall at the Charduar plantation has diminished considerably of late years, as will be seen from the table below, which Mr. Campbell supplied—

Rainfall at the Charduar caoutchouc plantation from 1878-79 to January 1884-85.

	1878-79.	1879-80.	1880-81.	1881-82.	1882-83.	1883-84.	1884-85.	Remarks.
April, ...	4·35	3·79	7·47	6·68	5·35	3·75	2·67	
May, ...	8·10	7·16	4·36	11·94	13·34	13·23	10·55	
June, ...	14·90	36·43	27·83	14·57	15·10	12·61	12·76	
July, ...	16·56	20·58	21·06	10·40	10·58	21·48	12·14	
August, ...	17·08	19·82	20·58	23·61	20·06	18·96	19·07	
September,	16·09	17·05	4·93	21·80	18·26	6·33	7·9	
October, ...	2·64	6·53	12·07	2·16	14·8	0·92	3·3	
November,	·66	...	0·90	0·09	0·68	0·28	0·18	
December,	...	...	1·35	0·28	0·88	1·24	0·37	
January, ...	...	1·57	0·58	1·95	0·54	2·66	0·65	
February, ...	...	1·04	0·76	2·42	0·47	1·35	0·50	
March, ...	...	7·52	6·24	2·92	0·92	2·11	1·79	
Total, ...	60·33	121·79	104·91	99·04	99·50	84·93	72·08	

This reduced rainfall may be due to forest clearings in the Assam valley, or it may only be due to unknown causes, and a cycle of heavier rainfall may occur in future years.

The caoutchouc trees in the lines planted in the ground are very healthy and vigorous; a few of those planted up in trees have sent roots down to the ground, and are also forming fine strong crowns, but this method, although it imitates nature, appears to give slow results compared to the plan of planting in the ground.

A fresh experiment of planting out small seedlings in the forks of trees is now being undertaken, and if successful would doubtless greatly diminish the cost of the work.

The right of collecting caoutchouc from the trees growing naturally in the Darrang forests was sold for five years for Rs. 22,000, and will expire in 1886, by which time the natural trees will probably be exhausted. It is impossible to protect them or to regulate the tapping, owing to their being so scattered in the forests. The planters are still afraid of the Akhas, who have not come down this year for their allowance from Government, and a detachment of 50 Sikhs from one of the Assam Regiments is stationed at the Balipara Haut. The two unfortunate Bengali forest subordinates who were carried away last year, both

retired into private life after their release by the Akhas. One of them could not keep up with the raiders, and was carried slung on a pole by his feet and wrists.

I spent two days in mahsir fishing up the Borelli river, but only caught five fish, none exceeding 60 lbs. in weight. Some heavy fish were caught last November by planters, but the fish were evidently shy at my visit.

Mr. Campbell told me that there is a little isolated patch of sál forest in the Lakhimpore district of Assam far east of the Borelli river, which has hitherto been looked on as the eastern limit of sál. He also informed me that coffee planting on a large scale has been commenced in the Nowgong district of Assam.

If coffee planting succeeds in Assam it will be some compensation for the extensive area of new tea cultivation in Ceylon, where splendid yields of leaf have resulted. It is probable, however, that the tea plants will not long stand the forcing climate and seemingly poor soil of Ceylon. All vegetation requires some rest, and the old tea plants in Dehra Dún, where the severe cold of winter and the dry west winds of May and June, necessarily put a long stop to tea making, is still perfectly healthy and free from any blight or disease, and contrasts well in this respect with the more luxuriant plant in Assam, though there are probably tea bushes in the Dún older than any in Assam.

Some experiments in growing the ceara rubber plant, *Manihot Glaziovii*, are being carried out by some tea planters at Tezpur, and there is no doubt that the tree grows luxuriantly in Assam, but no useful result as far as a yield of ceara caoutchouc is concerned has yet been obtained.

After leaving Tezpur, I visited the teak plantation on the Kalsi in Kamrup, and found it fairly flourishing, but the trees on the hilly ground do not look nearly so well as the first lot planted on alluvial soil, of which there is only a small area available above the flood level.

An average tree of 1872, sown by the late Mr. Aylmer, measured 2 feet 9 inches in girth and 60 feet in height, and the largest tree near the river side, and fully exposed to light, was 8 feet 9 inches in girth but only 40 feet high. The trees of the 1873 plantation average 1 foot 5 inches in girth and 40 feet in height, those of 1874 on the hill being about 35 feet high with an average girth of 1 foot 8 inches.

There can be no doubt that the teak in Assam grows much faster than sál, sain (*Artocarpus Chaplasha*) and other good Assam timbers, but to produce really good results a deep well drained alluvial soil above flood level is required. Besides teak there have been attempts to grow caoutchouc, for which the climate is too dry, poma, or tún, *Cedrela Toona*, which does not appear to thrive as well as in the Dún, and jarúl (*Lagerstrœmia Flos-Reginæ*) which is indigenous to the Kalsi valley.

Some maiphak seed supplied by Mr. Peal, which he reported

as a substitute for teak, have been sown, and there are some fine cinchona plants intended to be planted out in the Garo hills. The ceara rubber has also been grown successfully, and a plant from seed sown in 1879, measures 40 feet in height and 2 feet in girth.

The Kalsi forest house is situated on a hill with a fine view of the Kalsi valley with its forest-clad hills, and in the background are the Khasi mountains, rising to a height of 6,000 feet. Sál forest is growing almost everywhere on the rising ground, in many cases surrounding the paddy fields, and owing to the very successful fire conservancy the sál forest has improved wonderfully in the last 10 or 12 years since I first saw it, and is full of fine young growth. But thinnings and removal of badly shaped trees would surely yield some revenue, and would do a world of good. Owing to the absence of a demand for small wood, such thinnings have been neglected here, as in the Baxa forest, only the fine sál trees being sold, and the badly shaped ones being left to encumber the vigorous young growth of poles and saplings.

I append a report by Mr. T. J. Campbell regarding some experiments in collecting caoutchouc, which was published in the Assam Annual Report for 1883-84.

Account of an Experimental Tapping of 50 Caoutchouc or Rubber Trees (Ficus elastica) *in the Balipara Government Reserved Forest, Darrang District, Assam, in 1883.*

"A very interesting experiment was made in the tapping of 50 selected rubber trees in the Balipara Reserve, which was profitable, both in adding to our knowledge of the tree and in its financial aspect.

"The trees selected were located in the range of hills running south of the Bhairabi river after it debouches from the hills, and east of British boundary pillar No. 184. These hills are usually known by the names of the watercourses running through them. The western portion is a series of very precipitous hillocks, separated from each other by mountain torrents, richly wooded and containing some of the best timbers. The eastern portion is a series of elevated plateaux with very steep approaches, not so thickly wooded as the western end, but abounding in good timbers. There is a large number of rubber trees in these hills.

"The soil was mostly a rich sandy loam, particularly so in the valleys, where the accumulation of leaf mould was enormous. Some of the trees were on land, low enough to be inundated during the rains.

"All of the trees had commenced life as epiphytes, and in most instances had numerous aerial roots. The trees selected by these epiphytes are almost always those of broad-leaved species, such as Sam, Dhopabor, Serang, &c. The heights, diameter of crown and girths round aerial roots were measured of the selected trees, and the greatest, least and average of these is as follows :—

	Height in feet.	Girth in feet.	Diameter of crown in feet.
Greatest, ...	129	158	195
Average, ...	101	54	94
Least, ...	80	20	56

"The trees were selected, not for their size, which is simply average, but on account of their not having been tapped before, or else having recovered the effects of previous tapping. The trees were marked and numbered for future reference and comparison. The roots were not touched, nor were any incisions made less than 4 feet from the ground or less than 2 feet apart. The following table shows an abstract of the results:—

Locality.	Species.	How collected.	Trees previously tapped.		Trees never tapped before.		Total trees.		Average.		
			No.	Yield in seers.	No.	Yield in seers.	No.	Yield in seers.	Height of trees.	Girth of trees.	Diameter of crown.
									ft.	ft.	ft.
Valleys, ..	Shikabor	Liquid	..	..	8	42·0	8	42·0	118	65	96
" ..	" ..	Dry	7	23·75	6	25·75	13	49·5	100	..	..
" ..	Bogibor	Liquid	..	..	..	..	..	..	..	..	..
" ..	" ..	Dry	8	32·75	5	17·0	13	49·75	109	61	106
Crests of hills	Shikabor	Liquid	..	..	5	74·0	5	74·0	86	63	103
" ..	" ..	Dry	4	18·0	7	27·75	11	45·75	100	47	95
" ..	Bogibor	Liquid	..	..	..	..	..	..	..	..	..
" ..	" ..	Dry	3	11·75	3	8·25	6	20·0	99	45	78
			22	86·25	28	194·75	50	281·0			

	Md.	Srs.		Md.	Srs.
Liquid rubber collected, ...	2	36			
Liquid rubber loss, ...	1	22	sold	1	14
Dry rubber collected, ...	4	5			
Dry rubber loss, ...	0	5	"	4	0
Total, ...				5	14

"The difference between the "Shikabor" and "Bogibor" is simply that the leaves of the latter are of a palish green, instead of the full deep green of the former. The Assamese state that "Shikabor" has a sweet smell which accounts for its name.

"The difference between the "liquid" and "dry" is the mode of extracting. In the former case, small baskets are prepared and coated inside with caoutchouc, after which the basket is attached to the tree under the incision, and receives all the fluid. These baskets, when full, are emptied into cane receptacles coated with caoutchouc, preparatory to boiling down the liquid rubber. When boiled down, the result is usually found to be a loss of from half to two-thirds in weight, and there is a much further decrease during the time the rubber is drying.

"Fifteen seers of liquid rubber were boiled down and weighed five days afterwards, and found to be only 4 seers 6 chhataks: it was then kept ten days longer, when the loss was 6 chhataks more; after which it was kept for a further period of five days without any loss in weight and was then sold.

"Two maunds and 21 seers of rubber were boiled down and weighed the same day and found to be 1 maund and 22 seers; two days afterwards there was a further loss of 11 seers, and the next day 1 more seer. It was sold then, as there was no object in losing revenue through its losing more weight.

"This is decidedly the best way to extract rubber, as the yield is nice and clean, and the mode of extracting it will not admit of the incisions on trees being too close.

"Of the 4 maunds and 5 seers collected in a dry state there was but a loss of 5 seers in weight. This was mainly due to the long time this was allowed to dry on the trees; in some cases 20 days being allowed, instead of the usual 8 to 10 days. In this case, after making the incisions, the milk-like rubber flows freely over the tree, and is allowed to dry there, after which it is torn off, often carrying large quantities of bark with it.

"The trees noted as tapped before were those tapped by Mr. Martin when he leased the mahal. These trees have had from 10 to 15 years' rest, and have entirely recovered, the bark having grown over the incisions again. Their recovery is evident from the fact that their yield is as rich as that of trees never tapped before, though their greater age may have so nothing to do with this.

"The smallness of the yield is surprising and is wholly opposed to all preconceived notions on the subject. This is due to judicious tapping however, the actual possible yield not having been attempted.

"The financial aspect of the tapping was as follows :—

	Rs.	A.	P.
Cost of search, collection and superintendence,	148	1	6
Value realized at auction, ...	484	0	0
Profit, ...	290	14	6

"The high value received was due to the excellence of the rubber, which was very clean and without any extraneous mixture of bark, &c."

Mr. Campbell has just informed me that the 50 caoutchouc trees tapped in 1883 and 1884 have been tapped again this year, with a more satisfactory result, 40 trees having yielded 2 maunds 14½ seers of ball rubber and 10 trees 6½ seers of loaf rubber.

Note.—Ball rubber means such as is made up out of small pieces and strings of rubber, that are pulled off the bark of the trees where they were allowed to remain and dry from simple exposure to the air after the rubber in its fluid state had run out of the small incisions made in the bark; this kind of rubber is, as a rule, collected from the upper portion of the stem and branches of the trees.

Loaf rubber means such as was collected in a fluid state and then boiled down to assist coagulation, when it is formed into lumps, or loaves of various sizes and solid; this kind of rubber is, as a rule, collected from the lower portion of the stem and large aerial roots of the trees.

GRAZING IN THE FRENCH FORESTS.

In the May Number of this Journal the translation has been given of a note by M. Gazin on the practice of grazing in the mountains of Savoy. We will now proceed to a brief study of the provisions of the French Forest Code on the subject of grazing in the State forests generally.

Art. 63 provides that the Government can free a forest of all rights *in wood* by surrendering entire possession of a portion of the area to the right-holders. Art. 64 goes on to say that other rights of user, including grazing rights, cannot be commuted in this manner, but that they can be bought out by means of compensation fixed by mutual agreement, or in case of dispute by the Courts.

"Nevertheless, the commutation cannot be insisted on by the Forest Department in places where the exercise of the right of grazing has become an absolute necessity for one or more *communes*. If this necessity is disputed by the Department, the parties must go before the *Conseil de préfecture*, which, after an enquiry *de commodo et incommodo*, will decide, subject to an appeal to the *Conseil d'Etat*."

Here it should at once be explained the right of grazing sheep and goats is not included in the above provisions, for Art. 78 stands thus—

"All right-holders are forbidden, in spite of rights and actual enjoyments of the practice to the contrary to drive or cause to be driven goats or sheep into the forests or unwooded tracts belonging to the forests, under penalty, against the owners, of a fine double of that fixed by Art. 199, and against the herdsmen or shepherds of a fine of 15 francs. In case of repetition of the offence, the herdsman will be sentenced, besides the fine, to an imprisonment of from 5 to 15 days. Persons who claim to have enjoyed the above right of sheep-grazing in virtue of valid written titles or of a prescriptive right equivalent to the same can, if their claim is admitted, obtain compensation, the amount of which will be settled by mutual consent, or in case of dispute by the Courts."

"The grazing of sheep can nevertheless be authorized, in certain localities, by royal ordinance."

Neither goats* nor sheep are admitted into any forest which is under the *régime forestier*, as the grazing of these animals is considered incompatible with the maintenance of the ground under wood. The exceptional cases in which "in certain localites" and "by royal ordinance" sheep may be admitted only prove the rule. In localities where the grazing of sheep and goats cannot be prevented, the attempt to preserve the forests as such is not made.

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* The epithets which Manwood's Chief Justice seems to have applied to these animals have very properly been suppressed at p. 135 of Baden-Powell's Manual of Jurisprudence!

To return to Art. 64. When money compensation is awarded in lieu of grazing rights, it is paid on the marked cattle, and there is therefore no difficulty in knowing to whom the money is to go; but nevertheless there are manifest objections to this method of disposing of the right, and the author of an article in the *Revue des Eaux et Forêts*, 1881, page 188, remarks that it is a matter of regret that the law sanctions the exchange of a real servitude, belonging to the communes, for a sum of money, as this is to permit the present generation to dissipate the value of a patrimony as useful to future generations as it has been to those which are passed. Probably the best plan, in case it is absolutely necessary to get rid of the cattle, is to provide them with grazing grounds elsewhere, taking up land and converting it into good pasture where this is necessary; and this appears to be the only possible course in cases where it is decided that the right of grazing is an "absolute necessity" for the people.

Art. 65 of the Code lays down that in State forests which are not freed of grazing rights by the payment of compensation, the exercise of the right of user can always be reduced by the Forest Department in proportion to the condition and *possibilité* of the forest, and that it cannot be exercised at all except in conformity with the regulations contained in the subsequent articles. It is further stated that in case of dispute regarding the *possibilité* and condition of the forests appeal can be made to the *Conseil de préfecture*. By *possibilité* in this case is meant *possibilité* in grass, that is to say, that cattle must not be admitted in excess of the number for which there is a supply of grass, and the ground must not be overgrazed, the grass roots being pulled up and the soil trampled down so that the supply of fodder in future years is diminished. M. Briot says that all ruminants ought to get about 3·3 lbs. of dry grass daily for every 100 lbs. of their weight, but he also remarks on the obvious difficulty that exists in the determination of what the actual *possibilité* in grass of any forest really is. In practice it is not usual to make any calculation of this sort, but the effect of the grazing is carefully watched, and if it is thought that the number of cattle is too large, measures are taken to reduce it. The number must evidently in such a case be reduced somehow or other, not in the interest of the Forest Department, but in that of the people themselves, for if the ground is overgrazed, the production of grass is at any rate temporarily diminished; but the Forest Department also profits indirectly, for if the number of cattle is excessive and the supply of the food they prefer is insufficient for them, they are compelled to browse on the young trees, and thus to damage the forest seriously. All endeavours to reduce the numbers of cattle are, however, usually hotly disputed. As to whether the Forest Department has a right to improve the condition of the forest to the impoverish-

ment of the grass, the law is silent on this subject, but it is certain that grazing can be prohibited to the extent necessary in order to maintain the *status in quo*, whether by planting or sowing or otherwise. Unless, however, the demand on the forest in the matter of grass is less than the *possibilité* as above defined, so that the supply of grass can be diminished without a corresponding reduction in the number of cattle to be admitted, the improvement of the crop of trees in such a manner as materially to reduce the grass supply would at any rate be very strongly opposed by the right-holders ; and in this event it would be desirable, if possible, to do what has been above suggested in the case of forests which it may be wished to free entirely of grazing rights, *viz.*, to provide other grazing grounds to meet the deficiency caused by the improvements.

It is provided by Art. 119 of the general rules made under the Act that every year the local Forest Officers shall establish by a *procès-verbal*, having due regard to the nature, age and situation of the trees, the condition of the blocks of forest under the *régime forestier*, which can be made over for grazing ; they are to indicate the number of animals that can be admitted to them, and the dates on which the exercise of the rights of user may commence and must end. The proposals of the Forest officers are to be submitted for the approval of the Conservator before the 1st February in each year.

Art. 67 of the Code lays down that whatever may be the age or the species of trees, the right-holders can only exercise their rights in the blocks declared out of danger by the Forest Department (subject to an appeal to the *Conseil de préfecture*), and this in spite of all actual enjoyments of the practice.

Art. 68 states that the Forest Department will fix, according to the rights of the right-holders, the number of head of cattle that can be admitted to graze. Who then are the right-holders?

Art. 61 provides for the extinction of all rights of user not formally recognized either at the date of the promulgation of the present law, or subsequently in consequence of claims made before the tribunals within two years of the date of its promulgation. Art. 62 bars the accrual of fresh rights, and Art. 218 lays down the manner in which claims were to be dealt with. At present then no persons who do not possess formal titles are acknowledged to have any rights. The persons who possess grazing rights are not all owners or occupiers of land, but may be artisans and others. They can of course only possess the right in respect of cattle which are their own *bonâ fide* property. The title rarely prescribes the number of cattle which its holder has the right to graze ; sometimes it permits the exercise of the right without payment, but sometimes fees have to be paid.

Art. 69 of the code provides that every year before the 1st March the Forest Officers shall communicate to the communes

and private persons enjoying rights, the blocks which are declared out of danger and the number of head of cattle which can be admitted to graze; and the *Maires* are held responsible to publish the information in the communes referred to.

Art. 70 goes on to say that the right-holders can only enjoy pasture rights for cattle kept *for their own use*, and not for those which they buy in order to sell again, under penalty of a fine double of that prescribed by Art. 199. The right then only extends to cattle kept for domestic or agricultural purposes, and does not extend to the animals of cattle-dealers or butchers.

In order to enable the provisions of Art. 69 and 70 of the Code to be carried out, Art. 118 of the General Rules lays down that before the 31st December in each year the *Maires* of communes and private persons enjoying the right of grazing cattle in the State forests, shall submit to the local Forest Officer a statement of the number of head of cattle which each right-holder possesses, distinguishing those which he keeps for his own use from those with which he trades.

In Art. 71 of the Code it is said that the roads by which the cattle must go, in order to pass to and from the pastures, will be pointed out by the Forest Officers. If these roads traverse coppice or young high forest not out of danger, ditches sufficiently wide and deep, or any other kind of fence to prevent the cattle from getting in among the trees, can be made at the joint expense of the right-holders and the Forest Department, and in the manner indicated by the Forest Officers.

Art. 72 provides that the herd of each commune or section of a commune must be in charge of one or more common herdsmen chosen by the Municipal authorities; as a consequence of this, it is said, the inhabitants of the right-holding communes can neither take charge of their cattle themselves nor send them to graze under a separate guard, under penalty of a fine of two francs per head of cattle. The cattle of each commune or section of a commune are to form a distinct herd unmixed with those of another commune or section, under penalty of a fine of from 5 to 10 francs against the herdsman, and of imprisonment for from five to ten days in case of a repetition of the offence. The communes and sections are held responsible in respect of the sentences involving payment of money which may be pronounced against the herdsmen or guardians of the cattle, as well for the offences treated of in the chapter relating to State forests, as for other forest offences committed by them during the time of their service, and within the limits of the grazing ground. By Art. 73 and 74 of the Code it is provided that the cattle must all be marked with a special mark, (it is usually applied to the skin, but sometimes to the horn); the mark must be different for each commune or section, and for every head of cattle not so marked a fine of 3 francs is exacted. The right-holder is held responsible to deposit the impression of his

mark at the Recorder's office of the Court of First Instance, and the marking iron itself at the office of the local Forest Officer, under penalty of a fine of 50 francs. The deposit of the impression and of the iron must be effected before the time fixed for the opening of the grazing (Rule No. 121).

Art. 75 of the Code provides that the right-holders must put bells on the necks of all animals admitted to graze under penalty of a fine of 2 francs for each animal found in the forest without a bell.

Art. 76 lays down that when the cattle of right-holders are found outside the blocks declared out of danger from grazing, or off the roads appointed to reach them by the herdsman, may be fined from 3 to 30 francs, and in case of a repetition of the offence, he may be sentenced in addition to imprisonment for from 5 to 15 days.

Under the provisions of Art. 77, if the right-holders introduce into the forests a greater number of cattle than that which has been fixed by the Forest Department in conformity with Art. 68, they are liable, for the number in excess, to the penalties pronounced in Art. 199.

Regarding stray animals generally Art. 147 provides that persons whose conveyances, cattle, beasts of burden, or beasts for riding are found in the forests off the ordinary roads or paths will be sentenced as follows, *viz.*:—For each conveyance to a fine of 10 francs in case wood is 10 years' old and over, and of 20 francs in case the wood is below that age. For each head of cattle not harnessed in the carriages, to the fines fixed by Art. 199, and this without prejudice to liability for damages.

The last named Article is as follows :—

"The proprietors of animals found by day, unlawfully, in woods of 10 years' old and over, will be sentenced to a fine of

One franc for a pig.
Two francs for a sheep.
Three francs for a horse, pony, mule, donkey.
Four francs for a goat.
Five francs for an ox, cow or calf.

"The fine will be doubled if the wood is less than 10 years' old; all without prejudice to damages if any."

Under Art. 201 of the Code the penalty is always doubled in case of a repetition of the offence (*i.e.*, repetition within a period of 12 months), and when the offences are committed by night. The *proprietors* are prosecuted under Art. 199, and *in addition* the *herdsmen* are prosecuted under Art. 76. As to the area of forest grazing required per head of cattle, this depends on the nature of the rock and soil, climate, slope of the ground, and other fixed elements, as well as on the quantity of grass available and the state of the young growth, which conditions vary from point to point and change from time to time. It is not possible at present to furnish any exact guide. A note by Mr. Brandis

on this subject has appeared in one of last year's Numbers of this Journal, and M. Ga in says that in the Conservatorship of Chambery, Savoy, it is the rule to admit two head of large cattle per hectare (2·47 acres) from the 1st June to the 1st November between sunrise and sunset. This is in fir forests managed under the system of *jardinage*, and in blocks where felling operations have not been carried on for 10 years. It is said that the cattle do not eat the young fir trees. The figures given in the foot-note at page 133 of Mr. Baden H. Powell's Manual relate to the *entire area* of France in the one case, and of the Hautes Alpes in the other, and not as might be supposed to the forest area alone.

M. Briot makes the following statement in the *Revue des Eaux et Forêts* of August 1883 :—

"A word about forest grazing grounds. They are little valued. People would willingly do without them if they could, and even in the *Haute maurvenue*, where the best are found, *viz.*, those which shelter the larch forests, people use them very moderately. We have been told that in the neighbourhood of Mont Cenis, where the Forest Department opens the blocks, which are out of danger, from the 15th May to the 1st November, they are hardly used before the 12th June; after some date between the 28th June to the 4th July the cattle abandon them to disperse themselves over the mountains, except in the case of the highest compartments, in which the cattle of neighbouring pastures come to graze from time to time."

The people then do not require tree-shelter for their cattle, and from this point of view would like the whole country to be cleared of trees.

Much might doubtless be done in India to diminish the necessity for grazing in the Government forests if more attention were paid to the condition of the grazing grounds outside them. At present there is no doubt that the village waste lands are not always cared for as they should be, and that frequently nothing is done to make the most of them. The French Law of 1882 relative to the restoration and preservation of mountainous tracts provides among other things for the regulation of the communal pastures.

M. Briot has written a series of interesting articles in the *Revue des Eaux et Forêts*, 1880-81 and 1883-84, from which much can be learnt regarding the management of the communal grazing grounds in the French Alps. In his article of August 1883, pages 10—23, he gives the substance of various arrangements in force in Savoy.

The commune of Laus-le-Villard, Mont Cenis, gives to each owner of cattle a copy of the *Réglement rural*, of which the principal provisions are of the following nature, *viz.* :—The number of animals of each kind that can be grazed by each person is strictly limited ; some of the animals are grazed free, and for others fixed dues are paid : the sheep of strangers found grazing

within the communal pastures are paid for; grazing in common by cattle and sheep having been found "disastrous."

Separate pastures are assigned for each class; the dates between which the various classes of pasture are opened are fixed, and the roads by which they are to be approached are indicated; lastly, the cutting or mowing of grass before the 15th September is prohibited, and even after that date it can only be cut in rocky ground, precipices, and other places which are inaccessible or dangerous for all kinds of animals. This latter provision is of course intended to permit the grass seeds to fall on the ground; there can be no doubt that precautions with this object are necessary, especially in dry regions, where the production is not vigorous, and that the cutting and burning of the grass before the fall of the seed should be strictly prohibited not less than once in three years.

If some such measures as the above could be taken in India, the demand on the Government forests as grazing grounds might be much reduced.

F. B.

CYPRUS.

It may be useful to some of your readers to know that certain kinds of Eucalyptus are thriving well in the plains of this Island. In 1880-81 the seeds of some 40 species were obtained, and experimental sowings made; some of the seeds failed to germinate, the seedlings of others soon died off, but the plants of the following ten kinds have taken kindly to the climate and soil, and there are several thousands of them doing very well. These are—

Eucalyptus cordata.
,, *coriacea.*
,, *corynocalyx.*
,, *hemiphloia.*
,, *leucoxylon.*
,, *occidentalis.*
,, *polyanthemus.*
,, Red Gum (Tenterfield).
,, ,, (*resinifera*).
,, *rostrata.*

Some of the Red Gums have now a height of 30 feet, with a girth from 30 to 36 inches near the base. The above are mostly planted round Government House and the Public Offices, which are situated outside the town; formerly not a tree existed in the vicinity of these buildings. At first the *E. globulus* was the most generally planted, but their failure has been nearly

complete. Intermixed with the *Eucalyptus* are *Casuarinas*, *Acacias (A. cyanophylla, lophantha* and *pycnantha)*, *Schinus mole* (Pepper plant) and *Thuya*, all doing well, also the *Melia* (Indian Lilac) and *Ailanthus*.

Cyprus at times suffers severely from drought, but the last three years have been favourable, the rainfall averaging 20 inches in the plains. The soil is here mostly calcareous.

It may also be of interest to note that progress is being made towards "Conservancy," 20 square miles on the summits of the Northern mountains are now being closed against goats (cattle and sheep do not pasture on the mountains). Over 30 square miles of the Troodos range 'fellings' of Pines have been prohibited, and it is under consideration to close against pasture the whole or portion of this area. Shortly before the English occupation the cuttings in this forest had been carried on wholesale, and also the damage caused by over-tapping for resin had been immense.

I have lately returned from a visit to Syria, where the little remaining forest on the Lebanon mountains are fast disappearing. It is said the Turkish Government take no measures whatever to protect the forests, and as a result of this denudation, the heat in summer in the Lebanon villages is excessive.

NICOSIA: }
1st April, 1885. }

E. DOBBS,
Principal Forest Officer.

HOW LIGHTNING STRIKES TREES.

I do not remember seeing the article in February's "Forestry" reprinted in the "Indian Forester," and I do not see "Forestry" itself, so I do not know whether any attempt was made in that article to account for the various phenomena mentioned.

Arago in his Meteorology (I write from recollection after 25 to 30 years) accounts for a tree being struck by the fact that owing to its being full of sap it is a good conductor, and he says that the splintering is caused by the explosive force of the steam into which the sap is suddenly converted.

I do not think that COL. PEARSON's theory fits in with the facts I have observed. In 1871 I was at Simla during the rains, living in a house close to the Church, and a deodar of about 2 feet diameter (perhaps the largest then on the Simla ridge) just behind the house was struck. The upper half of the tree, including most of the branches, was knocked clean off, and the lower half was cleft widely down to the ground, the bark being peeled off in large sheets. There was not much splintering in this case, if I recollect rightly. In the same month, June I think, a small deodar was struck in Simla, and converted into matches, the bark being blown into fragments in all directions and to

some distance. This could hardly have been caused directly by the lightning which, the wet tree being a good conductor, must have passed into the ground; but Arago's theory would account for what happened, always supposing it possible that the sap of the tree could be so instantaneously boiled.

Last year there was a notable case, when a large deodar near the Municipal Hall, Mussoorie, was smashed to pieces. In all these cases, which happened in wet weather, the trees were quite moist, but yet did not escape.

Col. Pearson thinks that a tree when absolutely dry is nearly a non-conductor, and his impression is that it is then shivered to atoms. I presume he means—when the bark is absolutely dry. But the fact of the tree being struck at all shows that it is a conductor, and this is mainly owing to the sap it contains. Is there any instance of a dead tree having been struck? I have heard of lightning having been seen in Mussoorie to fly off in sparks from a strip of galvanized iron, used as the lightning conductor of an iron roofed house, to a tree close by, to burn the leaves.

Mussoorie. C. W. Hope.

FLOWERING OF CONIFERS.

I SEND a few notes about flowers and cones of the various pines.

Tos (*Abies Smithiana*).—The pollen began to fall about the 1st of May, and the new cones having become fertilized are fast closing up; in low elevations, 6,500 feet, &c., they are nearly all closed, at 7,500 feet they are still open, and ovules plainly visible. I do not observe any of last year's cones on the trees with the new cones.

The question is when will these new cones ripen? October 1885, or October 1886?

Rhai (*Abies Webbiana*).—Exactly the same as tos; the pollen is now falling, and scales closing up over the ovules.

Kail (or chil) (*Pinus excelsa*).—Same as rhai and tos; but when collecting the male flowers on 16th April last, when they were very young, and long before the pollen was ready to fall, I collected a cone about 2 inches long and over, with the scales all closed up; this would appear to be last year's cone? I have not yet found the new cones of this species, but am looking for them.

Referring to my former letter about the *Pinus longifolia*, it will be seen that I spoke of a second and larger cone which was growing at the base of the stem which held the tiny new cone; this is getting rapidly longer, and must, I should think, be

last year's, which will ripen next April; if so, it would appear that this species takes two years to ripen the seed. I am collecting specimens of all the different cones, and will send hereafter.

5th May, 1885. J. C. McD.

EDINBURGH EXHIBITION.

I SEE from the report on the Indian Section of the Edinburgh Forestry Exhibition that Colonel J. Michael, C.S.I., claims for himself the position as the first practical pioneer of the Forest Department. I do not know whether such claim is appreciated or even acknowledged by the Indian Forest Department.

If it is, I would urge, though I am quite willing to allow that an extremely large number of trees fell under Colonel Michael's direction, that Messrs. Sultan and Ter-Arratoon of the Punjab did as much, and even more, for the introduction of scientific forestry than the gallant Colonel. They cleared whole hill-sides of all parent trees, and thereby necessitated artificial reproduction, and their reckless exploitation forced us to adopt stringent measures of conservancy and methodical working. Honour to whom honour is due, Mr. Editor.

TER.

III. Official Papers.

THE BOXWOOD FORESTS OF KUMAUN AND BRITISH GARHWAL.*

The box forests of Kumaun and Garhwál are generally found on slopes with a north or north-west aspect, and at an elevation of from 7,000 to 9,000 feet.

Box is either found occupying a limited area, in which case it is often the dominant species, or else distributed regularly through extensive forests and mixed with other species, and it is in this condition that the finest trees are formed. On gentle, well-watered slopes, more particularly near the bottoms of ravines, where the soil is rich and the cover dense, the box finds the conditions of vegetation best suited to it. In these vast forests, often almost untouched by the hand of man, the ground is in the most favourable condition for forest vegetation. The detritus of generations, the fallen leaves and rotting branches and wood, have formed a deep and fertile humus, giving a perfect forest soil. The rock is generally limestone, huge boulders of which are often found scattered through the forest. The thicker and more dense the forest, the better the box. The full light crushes down the tree, as the shade does most other species. In open glades it is often found in considerable numbers, but always stunted and pressed down. The open light, then, appears to facilitate the germination of the seed, but to oppose the free growth of the tree.

Box is rarely found far from the snowy range. When quite close to the snows, however, though often numerous, it is badly grown and of little value. Thus the forests of Trijugi Narain and Tali Gwar contain a great number of trees, but they are stunted and crooked. This is probably due to the heavy snowfall of these places. The most important trees found associated with box are:—

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* Report by F. B. Bryant, Esq., Assistant Conservator of Forests, on the Box Forests of Kumaun and Garhwal.

Karshu,	..	..	..	*Quercus semicarpifolia.*
Moru,	..	..	..	*Quercus dilatata.*
Rai,	..	..	..	*Abies Smithiana.*
Morinda,	..	..	..	*Abies Webbiana* (rarely).
Panghar,	..	..	..	*Æsculus indica.*
Maple,	..	..	..	*Acer villosum.*
"	..	..	..	*Acer lævigatum.*
Yew,	..	..	..	*Taxus baccata.*
Walnut,	..	..	..	*Juglans regia.*
Holly,	..	..	..	*Ilex dipyrena.*
Cypress,	..	..	..	*Cupressus torulosa.*
Alder,	..	..	..	*Alnus nepalensis.*

With Rhododendron, *Pieris ovafolia*, the hornbeam, and many others.

In the undergrowth, gigantic ferns, currants and raspberries, with dense and almost impenetrable thickets of ringal, render the task of inspection difficult and uncertain.

The size to which the box will grow under favourable conditions has been generally understated. Mr. Brandis gives "15 to 16 feet in height with a girth of 20 to 30 inches." I measured one tree with a girth of 86 inches at 5 feet from the ground, and trees of 5 feet in girth with a trunk 25 feet to the first branch, and a total height of 40 to 50 feet are often to be found. Unfortunately, however, many of the bigger trees are unsound, and the best size to cut will probably be found to be from 2 to 4 feet in girth.

The reproduction of box in these forests is good, and the young trees are in sufficient numbers to ensure the future of the species in case felling be undertaken.

I do not think that the forests which I have noted by any means represent all that contain box. I often found the villagers suspicious and unwilling to show me the box in their forests, and I think it probable that in many of the moist shady valleys and slopes, with a northerly aspect near the snows, box may be found more or less.

Doubtless, however, the forests dealt with in this report will meet any demand that may arise for box-wood for many years to come. I can hardly venture to hope that the numbers of box trees as estimated by me will be found approximately correct. The trees are often so scattered and the under-growth so dense that, in the total absence of paths, inspection is very difficult. I have endeavoured to give in every case a moderate estimate, and though I have no doubt that there are often more trees than I have noted, I do not think there will ever be found less.

In case fellings be undertaken, the best place to commence will be the village of Mandal, Garhwál, in the vicinity of which a large quantity of excellent box is available from the forests of Panganbasa, Martolia, Dogana, and Chopta. There is a good

road running through these forests to Chamoli, and thence *viâ* Nandpryag, Karnpryag, and Lobha to Ránikhet is only 76 miles. Thence the wood can be carted to Moradabad at a cost of 8 annas a cubic foot. The estimate of cost in the tables at pages 16-17 are based on the supposition that a coolie will carry a cubic foot (65 lbs.) 12 miles for 4 annas, and if the work be done by contract more favourable terms may be obtained. The wood from the forests Nos. 1 to 10 might be delivered at Najibabad *viâ* Kotdwára for about the same cost as at Moradabad.

The total estimated number of trees is 25,000. Supposing a tree is fit to cut at the age of 80 years, we may thus fell 300 trees every year. The average tree will, I think, yield about 3 cubic feet; so 900 cubic feet per annum may safely be cut from these forests.

Mr. Bryant estimates that about 900 cubic feet may be cut in these forests annually, which is an equivalent to about 30 tons landed in England after allowing for dryage. According to Mr. Bryant's calculations the average cost of landing the wood at the Moradabad railway station will be about Rs. 2-5-0 per cubic foot, which is nearly 10 annas per cubic foot more than the cost of the last consignment from the leased forests to Saháranpur.

This, however, is not of much consequence, for it only amounts to about Rs. 18 per ton, and, besides this, the cost of carriage will probably be less now that the railway has been brought up to Kátgodam. None of the forests reported on are under charge of the Forest Department, and therefore I would suggest that a copy of the report be sent to the Commissioner of Kumaun, to enquire if the forests can be worked by the Forest Department, if Government so orders.

G. Greig.

MANUFACTURE OF CUTCH.

In a letter to the Conservator of Forests, Pegu Circle, British Burma, dated 5th August, 1884, Captain Wood writes as follows :—

I enclose an extract from the "Indian Forester" for July 1884, page 330, and beg to state that in my Circle the season for manufacturing cutch extends to only three months in the year, and that the rates levied here from catechu makers are 12 annas a pot, capable of holding about three gallons of water or liquid substance. The rate has been raised this year from 9 to 12 annas per earthen pot, which even seems to be a very low price compared with what you get in Pegu. I should feel much obliged if you would kindly give me the following information :—

(1). The length of the season during which cutch is manufactured in your Circle.

(2). The outturn per season per cauldron of 20 gallons.

(3). The process of manufacturing as conducted in Pegu.
(4). The price per maund of catechu on the spot.
(5). The distance of the market from the forests where the cutch is sold to retail dealers and others.
(6). What percentage of cutch is obtained from a maund of heartwood ?

The Conservator of Forests, Pegu, replied as follows on the 5th September, 1884 :—

1. Cutch is manufactured in this Circle from 1st June to 31st March ; but the months from December to March (inclusive) are those in which the manufacture is most energetically carried on. In April and May, and in the drier parts in March even, scarcity of water stops the work ; while in the rainy season carts cannot ply, and boilers have difficulties in provisioning themselves and disposing of their cutch.

2. The outturn of a cauldron per season depends on such a variety of circumstances—the duration of the season, the quality of the trees, their proximity to the boiling place, and, above all, the working days of the party, that an average cannot be struck. It may be 2,000 lbs. only, or it may reach, and even exceed, 6,000 lbs. for a cauldron of 20 gallons (those in use have a capacity of 12 gallons).

3. Mr. Carter, Deputy Conservator, Tharrawaddy, well describes the process of manufacture as follows :—

" For the working of one cauldron, three men are necessary ; but if a larger number of cauldrons are employed, there is some saving in labour. Of the three men, one man is employed in felling the trees, and dragging them, by means of cattle, to the cutch boiling place. The second clears the logs of sapwood, and cuts the heartwood into chips. The third attends to the fires and the boiling process. The chips are put into earthen pots, which are filled with as many chips as they will contain ; then water is poured in until the pots are nearly full. The pots (which have a capacity of about 3 gallons) are then placed on the fire and boiled for about 12 hours, in which time the water is reduced to about one-half the original quantity. For one cauldron, 20 to 25 of these earthen pots are employed. The cauldron is nearly filled from these pots, and when the extract in the cauldron is reduced to about one-half, the cauldron is again filled from the pots, and this is repeated until the pots are emptied. The boiling process is generally accelerated by the employment of a large earthen pot, which is set up near the cauldron, and is filled at the same time as the cauldron and kept boiling, the extract from the small pots being constantly added as that in the larger pot is reduced. The cauldron is then filled from the large pot, instead of from the small ones. The Burmans call this large pot the Ye-ni-o, or red water pot. The extract from the pots having all found its way

into the cauldron, the boiling is continued, and the liquid is stirred until it attains the consistency of syrup and fills only about one-fifth of the cauldron. The cauldron is then removed from the fire and stirred with a piece of wood, shaped like a paddle, for four hours or more, by which time the mass has obtained a greater consistency and is cool enough to be handled. It is then placed in a mould, like a brick mould, and is left to cool. This generally happens at night, and by next morning the result is a brick-like mass of cutch weighing 36 to 44 lbs."

The stirring business, which takes place after the cauldron is removed from the fire, is more of a beating up, and I have never been able to ascertain what the object or effect of the process is. Cooks differ too in the amount of beating up that is desirable, some being satisfied with half an hour's application. The out-turn of one cauldron of 12 gallons in 24 hours, when properly worked, is fairly constant at the figure given by Mr. Carter.

4. Cutch was worth last year Rs. 4·38 to Rs 5·58 per maund (equivalent Rs. 15, Rs. 20, and Rs. 25 per 100 viss) on the edge of the forest, according to the distance from the Irrawaddy river or the Railway.

5. The above rates correspond to some 40, 25, and 15 miles from the markets on the railway and river, where the price was Rs. 30 per 100 viss (365 lbs.), or Rs. 6·58 per maund.

6. Regarding the amount of cutch yielded by heartwood, no reliable data are available. The yield has been stated at from 3 to 10 per cent. in weight.

For practical purposes, I believe a ton of timber in the round may be taken to yield 250 to 300 lbs. of cutch.

The following note from Captain Wood closes the correspondence :—

It appears that in Pegu the cauldron is used for the final concentration, and the price is regulated by it. 20 to 25 pots of the size used in Oudh are used to supply the 12 gallon concentrating cauldron, so that the prices levied are much the same in both provinces, as will be seen by the figures given below :—

	Rs.	A.	P.
Pegu.—Price for 4 months' working 12 gallons cauldron, *i.e.*, 20 to 25, say 22½, 3 gallon pots = ...	20	0	0
22½ pots, at 12 annas = ...	16	14	0
Add ⅓ more for the 4th month = ...	5	10	0
	22	8	0

REPORT ON CERTAIN ASSAM SLEEPERS LAID ON THE NORTHERN BENGAL STATE RAILWAY FOR EXPERIMENT.

THREE several lots of sleepers were received from the Forest Department in Assam, *viz.* :—

(*a*). 100 Jarul, 100 Sama, 40 Gondsoroi, } received, latter end of 1879.
(*b*). 60 Gondsoroi, 100 Sida } received, July 1881.
(*c*). 20 Nahor, received, 4th January, 1882.

Of these lots (*a*) and (*b*) have been laid experimentally. The third (*c*) lot appears to have been received without any advice being given about them, so that they have probably become mixed up with and issued as ordinary sleepers for maintenance purposes.

Of the various kinds of sleepers supplied, the sama appears to be the best, as after more than five years' life in an unballasted siding there are still 71 per cent. in good and 12 per cent. in fair condition. No sleepers of these woods have had a fair test in a ballasted portion of the main line, except some sida (*Lagerstrœmia parviflora*) sleepers received at Siliguri, and which were not found suitable. I would therefore suggest that 50 or 100 sleepers of each of the following woods be obtained from the Assam Forest Department for further experiment :—

Jarul—*Lagerstrœmia Flos-Reginæ.*
Sama—*Artocarpus Chaplasha.*
Gondsoroi—*Cinnamonum glanduliferum.*
Nahor—*Mesua ferrea.*

Report on experimental Assam jungle wood sleepers, March 1885.

1st Lot (*a*). 240 sleepers laid in January 1880 in the new half mile extension of Kaunia goods shed siding (unballasted).

	Removed.	Condition.			Total.	Remarks.
		Good.	Fair.	Bad.		
40 Gondsoroi wood, mark G 79, Numbers, ...	1	19	9	11	40	Sleepers shown, as in fair condition, are slightly rotten, and those, as bad, are either badly split or rotten.
40 Gondsoroi wood, mark G 79, Percentages, ...	2 5	47·5	22 5	27·5		
100 Jarul wood, mark J 79, ...	7	48	11	34	100	
100 Sama wood, mark S 79, ...	2	71	12	15	100	
					240	

2nd Lot (*b*). 160 sleepers laid on 15th July, 1881, in the Rungpur Branch main line just outside western facing points, Kaunia Station (line ballasted).

60 Gondsoroi wood,
100 Sida "

Note:—Only 53 out of the 160 sleepers now bear marks, *viz.*, 17 with mark E 81, and 36 with mark S 81. These sleepers were marked with small tin plates bearing the marks and nailed to the sleepers. Only the nails which held the tin plate marks now remain in the balance of the 160 sleepers. The tabulated report is given below, but it can be of very little use except to give an idea of the relative value of a mixture of gondsoroi and sida wood sleepers as compared with sleepers of known woods.

	Removed.	Condition.			Total	Remarks.
		Good.	Fair.	Bad.		
Mark E 81,	...	5	3	9	17	Sleepers shown, as in fair condition, are slightly split or rotten, and those, as bad, are either badly split or rotten.
Mark S 81,	...	11	11	7	36	
No mark,	...	16	16	80	107	
					160	

A. GREENLEES,

Superintendent of Way and Works.

Note.—This report disposes of sida for use on Bengal railways, though it has been recommended under the name of dhaura for the Oudh and Roh lkhand line. It is a pity that nahor did not get a trial, as it is far more abundant in Assam than the other woods.—[ED.]

REPORT ON SPIDER SILK FROM KUMAUN IN THE NORTH-WESTERN PROVINCES AND OUDH.

Mr. J. F. Duthie, F.L.S., Superintendent of the Government Botanical Gardens at Saharanpur, recently transmitted to Sir J. Hooker, Director of the Royal Gardens, Kew, a specimen of spider silk obtained by him in Kumaun Mr. Thos. Wardle, of Leek, a well-known authority on Indian fibres and silks, who was consulted regarding the samples, furnishes the following report :—

"Sir George Birdwood has written to me enclosing some spiders' web and an extract from Mr. J. F. Duthie's letter. He asks me to examine this spider silk and to reply directly to you.

"The following is the result of my examination :—

"The fibre is evidently of a silken nature, and, like silk, it is loaded with a gummy substance. In a boiling soap solution this gum or varnish dissolves, leaving the fibre apparently pure and of the nature of fibroin, if not identical with it.

"Eight micrometric measurements of the diameter of the fibre in different parts of the mass showed great irregularity in thickness ([illegible] inch,) giving an average of $\frac{1}{3100}$ inch. It has therefore a considerably finer thread or fibre than silk, Italian silk averaging in thickness [illegible] inch.

"The average strength of the spider silk is proportionately greater than that of silk, a single fibre of the spider silk breaking with an average weight of $2\frac{1}{4}$ drams Avoirdupois, whilst that of China silk breaks at $2\frac{1}{3}$ drams.

"The most curious property of this fibre is its elasticity, which is considerably greater than that of silk; 30 centimetres of it will stretch to an average length of 36·8 centimetres before breaking, whilst China silk will only stretch to 34 centimetres.

"Like silk this spiders' web silk is lustrous and has a round fibre.

"Its coating of gum or varnish is disproportionate to the weight of the silk. On boiling with soap it lost 7¾ oz. per lb., that is, 1 lb. of the spider silk discharges 7¾ oz. of gum. With silk the proportion is much less, seldom being over 25 to 30 per cent. Before boiling in soap the spider silk was well combed to remove all the dirt possible, but a little remained.

"The fibre appears to dye readily. I enclose a small pattern of it dyed, and also one as I received it, and one after boiling in soap.

"I believe if it can be obtained in quantity, it might be packed in bales and sent to England, where it would readily find a market for being carded and spun into spun silk thread for sewing or weaving purposes.

"It is difficult to estimate its marketable value. I dare say it would at any rate realise 2*s.* per lb. It is rather dirty, and this would to some extent detract from its value as compared with silk waste.

"I have tried to discover how many seripositors this spider has, but beyond noticing under the microscope that the fibres often run in pairs, but not regularly, I am unable to trace whether there are two, as in the ordinary silkworm, or more. Probably an examination of the spider would show this, or an undisturbed portion of its secreted silk."

Mr. Duthie believes that, if a large supply of the spider silk were wanted, it could easily be obtained near the lake at Bhim Tal in Kumaun after the rainy season is over.

CULTIVATION OF *CRYPTOSTEGIA GRANDIFLORA* IN BOMBAY.

THE seed of the *Cryptostegia grandiflora* is reported to have germinated freely in Násik and Satara, and the seedlings to be doing fairly well. In Thána the results were not so favourable, as by far the greater number of seedlings that germinated died off.

In Sholápur the seed is said not to have germinated; this is due probably to mismanagement. In the Panch Maháls the seed supplied was destroyed by rats. In Nagar the seed was not sown, as the plant is known to grow there like a weed.

I may add that this plant is cultivated in gardens in nearly every station in India, and can be easily propagated; the experiments made by the Divisional Forest Officers prove nothing more than what was already known about the plant to those who are interested in it. The cost of collecting the sap would be so great that a plantation is not likely to be commercially successful. The plant grows wild in the Western Ghâts.

J. G. McRae.

IV. Notes, Queries and Extracts.

THE VALUE OF THE EUCALYPTS AS TIMBER TREES.

By D. Howitz, *Forest Conservator.*

The Eucalypts, or Gum-trees as they have been called, have of late years attracted a great deal of attention on account of their healthy properties, but their value as timber trees has hitherto not penetrated to the great markets. There have been several reasons for this, the distance from far-off Australia, their native place, the difficulty of transport to the shipping place, the peculiarities of the wood, which as a rule is very heavy and hard, and last, but not least, that people have not known the quality of these timber trees, nor quite understood how to treat them. There is as yet a large field open for experience with these trees, but as it is likely that they will play a prominent part in the near future, it may not be without interest to know a little of their general character and utilization.

The first objection, *viz.*, the distance to the great markets, will in a few years be somewhat modified by the introduction of the more valuable Eucalypts on a large scale into the countries around the Mediterranean, and particularly in the colony of Algiers, where the cultivation of these valuable trees is being executed at a great rate. As the Eucalypt timber gets more known, the demand for the more valuable kinds and dimensions will also cause a brisker trade in Australia, and thereby lessen the freight and the cost as better means of obtaining these dimensions are discovered.

Foremost amongst the Eucalypts, of which a couple of hundred species are known in Australia, the great home for the whole Myrtle family, stands the Jarrah tree (*E. marginata*) of Western Australia, where it is found on the ironstone ranges along the coast. The exact extent of the vast forest containing Jarrah timber cannot be exactly ascertained, as this tree gradually gives room for other trees, but Baron von Müller, the celebrated botanist, maintains that the belt stretches from the Collie River as the southern boundary as far as the Hershel ranges, in a width of varying size. The wood is brownish, and if taken from dense forest of a straight and even texture, hard, resinous, closely grained, and particularly from rocky ground of

an oily appearance. It receives a fine finish and polish, and ship-builders prefer it to teak and oak. This wood is exceedingly durable, but its chief virtue consists in the now recognised fact that it resists the attack of the "teredo navalis" as well as that of other insects destructive to timber in exposed positions. It is therefore extremely well suited for piles, wharves, railway sleepers and telegraph poles, and as it also resists the attack of fungi or rot caused by putrid water, it should find a prominent place as wood pavement. In Australia it is a common theory that vessels built of this wood do not require copper plating, a fact only mentioned to show that it resists animal or organic parasitical life. India has already during several decades been monopolizing this tree for railway sleepers, and a great export trade has long taken place from Perth to various places in India. On the south-eastern part of Australia is found a congener, called the Bastard Jarrah (*E. botryoides*), which resembles the Jarrah, but its wood is not so durable or oily and does not resist the attacks of insects so well. The Bastard Jarrah is found in Gippsland, in the colony of Victoria, where it forms fine forests. It grows taller and furnishes straighter and larger dimensions than the Jarrah, and though not so durable as that tree is still a most valuable timber tree. In Western Australia there were about thirty saw-mills in 1882, and most of these were only employed on the Jarrah for sleeper-cutting.

The next in rank should be the Red Gum (*E. rostrata*), on account of its durability when used for underground work. This tree is a native of Southern Australia, where it is found on river flats, in swamps, and on the plains. The wood is reddish, resinous, hard, works well, and receives a high degree of polish. Ship-builders utilize it extensively for all purposes where strength and hardness are required. If used for planks the wood should be steamed before use. This tree is being cultivated largely in Algiers, and it will not be many years before its presence there will make itself felt on the flats at Lacalle, and near Bona, where this tree seems to prosper and grow exceedingly well, but no information is as yet to hand about its timber value. For railway sleepers it is extremely well suited, and even in very awkward positions it has been known to last for upwards of 23 years before showing signs of decay. Also for wood pavement this timber should be utilized ; and as it resists the attacks of insects nearly as well as the Jarrah, it should take a prominent place in importation for that purpose. To this class belong also the so-called "Flooded Gums" of South Australia and New South Wales, but as transport to the seaports is difficult, and they do not play a very prominent part, they are only mentioned here.

There are many more valuable Eucalypts, but I will not weary the reader with their names and descriptions, and only remark that amongst them are found the hardest and most

durable woods known, for experience has shown that some of them are practically everlasting as fencing posts and sleepers, wear and tear, of course excepted. The large giant tree, the Stringybark (*E. obliqua*), furnishes immense dimensions of a light fissile wood, useful for shingles, rails, &c., and when it becomes more known, perhaps some more paying use might be found for it, while some of the mahogany Eucalypts furnish beautiful wood for cabinet-making and ornamental work. With the present facilities for transport it is a curious fact that these timber trees are so little known in the timber market, where they ought to take a very prominent place, and it is also curious that the greatest part of these woods are exported to India and to America, while Europe knows little or nothing about them. The most practical way to test the value of these timber trees would most likely be to form a company of timber merchants to deal with the matter, and then, after having communicated with the various agent-generals in London to send a practical man out to make himself acquainted with the various places, and to form business acquaintance with the saw-mill owners, so as to secure a supply of good timber to throw on the market. I have no doubt that the public would back such an effort, and I feel sure that the Australian colonies would, singly and collectively, do their utmost to aid the success of the undertaking, whereby everybody would be a gainer.

The next important Eucalypt should be the Karri of Western Australia (*E. diversicolor*, Müeller) on account of the large dimensions of a straight even-grained timber which it furnishes. This timber is much sought for masts and ship-building, and is not so heavy as the before mentioned, but of a lighter and more elastic character. The tree is of a rapid growth and reaches a great height and considerable girth. In the valleys and on the flats in South-west Australia colossal Karries are found, frequently reaching a height of 300 to 400 feet and a girth of 40 to 50 feet about 6 feet from the ground, but it is rarely found except in mixture with other Eucalypts. Most important is also the so-called Ironbark tree (*E. Leucoxylon*) found mostly in Southern Australia, although it does not furnish such large dimensions as the above named. The wood of this tree is close grained, firm, and of remarkable elasticity and durability. Carpenters, ship-builders, and wheel-wrights use it, and for treenails, rudder stocks, belaying pins, blocks, &c., as well as for wheels, spokes, &c., it cannot be surpassed. There are already several saw-mills at work, and there is room for many more, as the supply is very great. For axe handles and handles in general it excels the hickory (*Carya alba*) both as regards durability and elasticity, and as this valuable tree prefers a rocky, stony ground it will most likely be cultivated to a very large extent on the otherwise useless ranges. This tree has received some attention in Algiers, whence it may confidently be expected that a good supply will

be obtained before many years. The Ironbarks of New South Wales and Queensland furnish also most valuable timber of this kind, and will, no doubt, be cultivated largely as soon as the demand for them arises; but the ignorance of the European market with regard to them has caused them to be but little appreciated as yet, and consequently the forests have not been properly protected.—*Timber Trades Journal.*

SCHOOL OF FORESTRY AND MUSEUM.—The lithographed circular to proprietors and others largely interested in the subject, signed by the Marquis of Lothian, was issued on January 28th.

The Committee, in a note, state that they feel a difficulty in suggesting a definite scheme for the proposed School of Forestry, until they have some knowledge of the amount of funds which may be placed at their disposal; but, in the meantime, it may be sufficient to state that they contemplate the establishment of a Professorship of Forest Science, for the instruction of students in all that pertains both to practical and scientific forestry—including the physiology and pathology of trees, the climatic and other effects produced by forests, the different methods of forest management, the economic uses to which forest products have been or may be applied, forest engineering, and forest administration generally. Instruction is to be communicated by lectures, examinations, excursions, &c.

A large collection of forest implements, produce, and specimens was, at the close of the Forestry Exhibition, placed at the disposal of the committee for use in connection with the proposed Forest School; and it is the intention of the Committee, should their funds permit, that this collection should, with such additions as may from time to time be available, be placed in a permanent museum in connection with the School of Forestry.

The Committee earnestly trust that sufficient funds may be subscribed to warrant their proceeding with the objects they have in view, and that Great Britain, with her enormous forest interests in all parts of the world, may no longer be almost the only civilized country without an efficient School of Forestry. Intimations of subscriptions are to be made to Colonel Dods, Secretary, at the United Service Club, Edinburgh. An after appeal will be made to the general public. The Council of the Scottish Arboricultural Society have agreed to recommend their constituents to vote £50 from the Society's funds for the above object.—*Forestry.*

ORIGIN OF THE SAHARA.*—From the observations made at various points in recent times it has become more and more evident that the Sahara can no longer be regarded as having been a

* From Review of Dr. Oskar Lenz's Timbuktu, *Nature*, April 16th, 1885.

marine basin at least since the early Tertiary epoch. The theory may be said to have received its *coup de grâce* from Dr. Lenz, who plainly shows that the whole of the western section traversed by him is not a depression, as has been assumed, but an irregular plateau standing in the north at a mean elevation of from 800 to 1,000 feet, and even at Taudeni, its lowest level, still maintaining an altitude of 400 or 500 feet above the Atlantic. The surface is varied with stony and sandy tracts, the so-called "areg" or "igidi," which have nothing in common with marine sedimentary deposits, but have, in fact, been produced by the weathering of sandstone, quartz, and carboniferous limestones, which appear to be the prevailing formations. It is thus evident that this part of the desert has been dry land for vast ages, and the same conclusion must be inferred from the numerous dried-up watercourses, whose deep channels are distinctly the effect of erosion. These wadies, many of which seem to have been flooded within the last few thousand years, radiate from the central highlands north and north-east to the Mediterranean, east to the Nile, south to the Tsad and Niger, west to the Atlantic. Hence down to comparatively recent times the Sahara was a well-watered and wooded region thickly inhabited by agricultural and pastoral communities, themselves the descendants or successors of still more primitive peoples, the contemporaries of Palæolithic and Neolithic man in other parts of the globe. In the Taudeni district, about 20° N., under the meridian of Timbuktu, Dr. Lenz discovered some implements of hard greenstone well worked and polished, and similar objects have also been found by Gerhard Rohlfs as far west as the Kufara oasis south of Tripolitana. The Asiatic camel is here a comparatively recent intruder, preceded by the Garamantian war-horse and by the elephant, trained also to war by the native Numidians and Phœnician Carthaginians. The crocodile even still survives in many of the pools and lakelets here and there marking the course of mighty streams, which formerly sent their perennial floods down to the surrounding marine basins.

Apart from possible cosmic influences, our author attributes the great change that has taken place within the historic period, not with Peschel to the dry north-east Polar winds, which in the Sahara yield to the prevailing northern and north-western atmospheric currents, but largely to the reckless destruction of the woodlands which at one time covered vast tracts in this now arid and treeless region. With the vegetation disappeared the moisture; all the large fauna became extinct, and the settled populations were succeeded by nomad tribes of Berber (Hamitic) stock, joined later on by Semites from the Arabian Peninsula.

OBITUARY.—We have heard, with very great regret, the news of the death, on the 5th of April, at Badbol in Germany, of Mr.

Edwin Fuchs, Assistant Conservator of Forests, in Bengal. He was appointed by the Secretary of State to the Forest Department, in 1871, and after studying in Germany, reached India in December 1873, and was posted to the Kuch Behar division in Bengal, early in January 1874, where he was chiefly employed in making valuation surveys in the Sivôk Hills; he was attached to the Darjeeling division, from April to July 1875; in temporary charge of the Julpaigori division till January 1876, and then of the Buxa sub-division till 1878, when he was transferred to the Teesta division. In 1880, he was posted to the Hazaribagh division, his work being chiefly in Singbhúm, where he remained till he availed himself of furlough, on medical certificate, on the 15th May, 1883. Whilst on leave he served as a juror, at the Edinburgh Forestry Exhibition.

His chief work has been the demarcation of reserves in the Buxa Duárs of the Julpaigori district, in the Kalingpong subdivision of the Darjeeling district and in Singbhúm, and for his good management and excellent services, especially in the unhealthy Singbhúm forests, he was specially commended by his Conservator, and by the Lieutenant Governor of Bengal. His health has suffered considerably, first in Buxa and subsequently in Singbhúm, and he has consequently been frequently compelled to avail himself of sick leave, at intervals throughout his service.

As the reserves are demarcated, and proper accommodation is provided for Forest officers, forest work in such unhealthy forests as those of the Bengal and Assam Duárs, and Chota Nagpur loses much of its dangers, but it should not be forgotten that much of the progress made in India is due to the brave self-devotion of men like the late Mr. Fuchs, on whose services as pioneers of unexplored forests the future success of our department is largely based.

A CONTEMPORARY learns that the Forest Conservators and the Board of Revenue at Madras have reported unfavourably on a suggestion that a School of Forestry should be opened in connection with the Agricultural College at Saidapet. It is considered that the present plan of sending students to the Forest School at Dehra Dún cannot be improved upon. It is further pointed out that in any case Saidapet would not be a suitable place for such a school, inasmuch as the place does not possess the forest surroundings requisite for practical instruction.

We wonder whether the Poona Forest classes, which are attended by Forest subordinates in the Bombay Presidency, have greater advantages than Saidapet, or whether the students there pass ten months in practical forest work in forests organized like those of the School Circle, North-Western Provinces, under the constant instruction of experienced Forest officers.

It would also be interesting to know whether training in practical surveying, equal to that of the Imperial Forest Survey, is provided at Poona.

We have heard that the Bombay Government object to the distance of Dehra, but this is found no obstacle in the case of Baroda, one of their own States, which sends Forest students to Dehra in preference to Poona, nor in the case of Madras, Assam, and Burmah, which are certainly less accessible to Dehra than Bombay.

CINNAMONUM OBTUSIFOLIUM.

Mr. Peal writes that *Cinnamonum obtusifolium* is wrongly named, the leaves being fairly *acute*, unless bitten off by insects, which is commonly the case, and this may have given rise to the idea that they are *obtuse*.

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FOREST CONSERVANCY IN BOMBAY.

WE give the leading article from the *Bombay Gazette* and "Bhugut's" letter, which gave rise to it, in full :—

"Last mail brought news of Mr. Slagg having interpellated the Under-Secretary of State for India on the 28th April as to whether the recent policy of the Bombay Government to appropriate as 'protected forest' about 1,000 square miles of wooded land in the Tanna district, had not caused serious discontent among nearly a million of people 'whose trade and agricultural and domestic necessities had been seriously affected thereby,' and whether Mr. Cross could give or would obtain information as to the reasons which were held to justify the action of Government. Mr. Cross in reply had to confess that the 'enforcement during the last 15 or 20 years of these restrictions has caused some discontent.' It is perhaps to be regretted that Mr. Slagg did not mark his appreciation of the meagre information vouchsafed by the Under-Secretary, by a motion for laying the entire correspondence on the subject on the table of the House. As it is, the impression made upon the mind of the House by the off-hand admission that 'some' discontent had been caused by the present working of the forest rules, could not but have been of a very fleeting character. In the absence of the official papers, the public has to rely upon such facts as are supplied through non-official channels.

"We invite attention to a very important letter, given in another column, from 'Bhugut,' putting forward 'A plea for the Forest Tribes.' From the statistics given he shows that the question of the scientific forest conservancy affects nearly two millions of people in the Bombay Presidency, and he warns us that if their grievances are not carefully taken into account by Government, 'they will be apt, sooner or later, to assert their rights, or what they consider to be their rights, in a very awkward and indiscriminate fashion.' One thing to be noted in regard to these tribes is that they have been denizens of forests from times which date as far back as the conquest of India by the Aryans. These non-Aryan classes were driven to the mountain fastnesses of India as the Aryan conquerors overspread the country. There they remained unmolested for centuries, though the country was submerged by successive waves of conquest, from the Hindu to the Afghan, from the Afghan to the Mogul, from the Mogul to the Maratha, and from the Maratha to the British. They were left there in the undisturbed possession of the lordship of the

jungles, and their rights to the free use of its produce. Our correspondent gives a sketch of the habits and modes of life of the tribes, and of the hardships to which they have been subjected by the working of the rules under the Forest Act. Those who are in doubt about the reality of the grievances of these wandering tribelets cannot fail to observe the significance of the growing friction between Forest Conservators and Collectors in the districts, as evidenced in the last administration report of the Forest Department for 1883-84. We find, for instance, that under the authority of Government Resolution No. 5977 of 12th November, 1880, the District Collector is empowered to make free grants of timber to poor people whose houses have been destroyed by fire or floods. Under the orders of the Collector, the mamlatdars have the power of making such grants. The complaint of the Forest Department is that, under existing arrangements, these free grants are not made on a just principle. Lieutenant-Colonel McRae, the Conservator of Forests, Northern Circle, remarks that 'the Department that enjoys the privilege of making the free grants, and gets credit for them in the goodwill of the people, is not the custodian of the material given away, bears none of the disagreeables connected with making them, and is put to no expense by them.' He accordingly says that it would be more appropriate if applications for free grants of timber were made in the first instance to the officers of the Forest Department. Upon this Mr. E. P. Robertson, the Commissioner, C. D., remarks:—

"I must take objection to Colonel McRae's remark that under existing arrangements the free grants of timber are not made on a just principle. It is clear that the Forest Department, who have their own duties to attend to, cannot properly judge who are the indigent people whose houses have been destroyed by fire or by floods, who should be relieved by grants of timber. It is only the Revenue officers who can secure the necessary information, and to obtain such information often requires no small amount of inquiry as to the facts of each case and the circumstances of the people in question.' Mr. Sheppard, Commissioner, N. D., while admitting the necessity of increased liberality in the mode of making free grants of timber, observes:—'I am not able to believe that in jungle districts the Forest Department, however strong, can guard the interests of Government as effectually as the people can, and more should be done to conciliate them, and to make the Department less unpopular.'

"The present unpopularity of the Forest Department is thus admitted, and indeed it would be useless to ignore it. The plea put forward by our correspondent deserves very anxious consideration. We are so convinced of the value—indeed of the indispensable necessity—of forests, that any merely captious or exaggerated criticism of the process essential to their existence and restoration would receive no sympathy at our hands. But there is such a general agreement amongst disinterested on-lookers that the rules are enforced to the serious detriment of large numbers of the population, that it is impossible to resist the conviction that the time has come to make a thorough inquiry with a view to ascertain how the imprescriptible rights of the wild tribes who dwell in the jungles, and of the villagers who are settled on their outskirts, can be reconciled with the conservation of the forests. It is the impression of careful observers that

much of the hard-and-fast application of strict rules which gives rise to a sense of injury and oppression, is due to the numerical inadequacy of the staff of the Forest Department. A great deal of mischief certainly arises from the disproportion between the thousands of square miles to be overlooked and administered, and the mere handful of officers who are charged with the duty. For one thing, the forests, in spite of the harshness of the enforcement of rules in certain areas, are very badly protected taking them all round. In some localities the lopping of a twig entails exemplary punishment, but in others trees are felled with impunity, and consequently with recklessness. If the headmen of the vil ages were led to understand that it would be for the eventual advantage of the villagers, and for their own immediate advantage, to take some pains to allow the young trees to grow, and prevent waste and mischief, a very efficient staff of guardians of forest rights might be trained up. Surely it cannot be beyond the resources of administrative skill to bring the patels to look at the matter from this point of view. The forest produce, which is of little or no intrinsic value to Government, should be freely given to those whose traditional property it is; the chief condition insisted upon being that growing trees should not be injured, or made away with."

A Plea for the Forest Tribes.

To the Editor of the "Bombay Gazette."

"Sir,—We have read a good deal lately in your columns about the rights and wrongs of the forest tribes in connection with the bran-new system of scientific forest conservancy which the Government are now laboriously attempting to introduce in various parts of this Presidency; but few persons appear to have any correct idea of the extreme magnitude and importance of the subject in its bearing on the interests of the forest tribes and general population of the country. Of whom, then, do these forest tribes consist, and what are their approximate numbers? Full information on both points will be found by all who seek for information in Mr. Campbell's admirable 'Gazetteer,' and in Mr. Baine's 'Census Report of 1881.' Mr. Campbell's account of the forest tribes under each district head contains, I think, all that most persons will care to read, and all at any rate that is essential to be known on the subject; and the following figures, taken from Mr. Baine's 'Census Report of 1881,' will give some idea of the numbers of the chief forest and aboriginal tribes which inhabit the hills and mountain ranges in various parts of the Presidency:—

Bhil, ...	3,47,220
Varly, ...	69,534
Kathodi or Katkari, ...	51,283
Thakur, ...	64,789
Dubla, ...	10,883
Chodra,...	34,465
Dhodia,...	58,879
Naikada, ...	26,289
Dhangar, ...	10,584
Total, ...	6,73,876

"Many minor castes, such as Gamtas, Chor Patils, Wagris, &c., add to the general population of the forest tribes, and no account has been taken of the extremely numerous class of Mahars and Kolis—both Ghati and Konkani—which form a very important element in forest villages, and which are, as regards their habits and occupation, practically undistinguishable from the aboriginal tribes. The Mahars alone are estimated to amount to 2,52,523, while the Ghati Kolis are reckoned at 8,44,146, the Konkani Kolis at 1,20,006, and the miscellaneous Kolis—exclusive of ten Talabdas of Gujerat—at 1,17,397.

This, then, is the vast community which has a deep, nay a vital, interest in what is euphemistically called by some conservancy, by others confiscation, of the forests. Though ordinarily dumb and inarticulate, a community as numerous and as prolific as this cannot well be overlooked in connection with any scheme of scientific forestry; and if the forest tribes be not carefully taken into account they will be apt, sooner or later, to assert their rights, or what they consider to be their rights, in a very awkward and indiscriminating fashion. These forest tribes and early races have from time immemorial taken up their habitation in the hills. The ghats and upland fastnesses are their natural home; and amidst all the dynastic changes of many centuries the lordship of the jungles they have hitherto held unquestioned with the tiger and the bear. Averse to settled industry in any shape, they lead a nomadic and precarious existence. Their mode of tillage, locally known as Koomri and Dahli, is of the roughest and most wasteful kind. They strip a hillside in order to raise a few middling crops of nachni and vari; and their faith in rab or wood ash manure is at once childlike and grand. Wood-cutters and charcoal-burners by hereditary right, these tribes have hitherto filled an important and well-recognised place in the social economy. They have always supplemented their scanty earnings by vending to the community various edible kinds of fruits and roots, the leaves of the palas and apta, honey, gum, and divers other articles of a similar character. Forest produce of this kind was the natural heritage of the jungle tribes who collected it, often with much toil and labor, and always under conditions that gave them a clear right to the profits of their own industry. They not only collected but distributed these products, and were in fact the only agency by which the demands of the local market could ordinarily be supplied.

"Armed with bow and arrow or light bamboo spear, many of them are great hunters, and they are not at all particular about what they eat. They worship the brab and cocoanut palm, which supplies them with toddy juice, which they regard as veritable meat and drink. When fresh they find the juice a wholesome and pleasant stimulant, and to a half-starved people an invaluable substitute for food. Formented, the juice is universally esteemed as a febrifuge. It enables the jungle tribes to defy with impunity the deadly malaria of the valleys and the water springs choked with poisonous vegetation. A prophylactic against sickness, a universal remedy against all jungle ailments, a god-given food—the fermented juice of the toddy-tree is regarded by the jungle tribes as one of Vishnu's greatest gifts; and the intoxication which so excites our modern British Pharisees—for intoxication is of course unknown in England—may be readily condoned in the case of half-savage races which advancing civilisation has proscribed,

and which are compelled to wage for bare existence a constant and unequal struggle with all the perils of the hills and woods, perils of air and perils of water, perils of men and perils of beasts, perils of hunger, sickness, and death.

"Clothes they wear of the scantiest. A rag or string round the loins; a necklace of beads; and hair tied up in a knot; eyes blood-shot; lineaments pinched and worn, telling of many a hard struggle with hunger and thirst, heat and cold, fever and small-pox; puny of stature, and as a rule hideously ill-favoured, these wild men of the woods present at once an interesting study, and an important problem to the philosopher and the statesman. What is to be done with them; how are they to be employed; how can they be made useful members of society? This is the manner of man upon whom the new forest rules have fallen like a fatal blight—like a thunderbolt from a clear sky. By one direful stroke of the pen he finds himself at once a proscribed outcast in his own wilds. His hills and jungle fastnesses are suddenly proclaimed to be State forests. Every vegetable and mineral substance therein is declared to be 'forest produce.' All forest produce is declared to belong to the Crown. And no one is allowed to move any forest produce whatever without the formal permission of the 'jungle-walla sahib,' the new forest king. The new king, moreover, is no *roi fainéant*, but a terrible white man, a typical sahib, painfully in earnest, sworn to protect every green tree, a deadly foe to every black man armed with the axe. Does a wretched Varli scratch clean half an acre of slope and cover it with a layer of bushes and scrub, all ready to burn—down comes the forest guard and arrests him for committing waste! Does he lop a kheir or an ain tree, or any of the hundred and one kinds specially reserved—away with him to the magistrate for injuring Crown property! Does he cut a few reeds for his hut, or bamboos for his cattle shed—he is a thief (God save the mark), he has stolen public property! Does he carry to the nearest bazaar a few common rafters for sale—he has taken what does not belong to him, he has no permit, he must forfeit them! Does he collect for his own use a little store of mowhra flowers, or korinda berries, or nuts, or edible roots, or what not,—poor fool, he little knows that he is committing a crime, that mowhra flowers and all other forest produce are no longer his, that they are all put up by contract to the highest bidder, and that all property in them is transferred to the neighbouring Parsee or Hindu contractor! Of course he is 'fully informed'—(this phrase has now become classical)—that all this is done for his own good, that the mowhra belongs to the Queen, that illicit distillation must be stopped, that intoxication is a great sin which cannot be allowed under a moral British raj, &c., &c. Admirable and excellent reasons to Mr. Conservator Jones, but not, I fear, equally convincing to poor Rama Bhil, who points to his pinched stomach and thinks ruefully how the wolf is to be kept from the door. It is believed to be a moot point whether snakes and jungle fever are or are not 'forest produce' within the meaning of the Act. The Advocate-General is believed to have once expressed the opinion that the term 'forest produce' for the purposes of the Forest Department includes everything in a forest which might under any conceivable circumstances be turned to pecuniary account. It may fairly then be argued that if any poor Bhil were to make a

profit out of catching snakes or curing jungle fever he might fairly be prosecuted for attempting to appropriate forest dues which clearly belong to our energetic and omnivorous Conservator.

"Now, Sir, I do not question for a moment the excellent motives of the Government and its officers in seeking to protect the forests and to reclothe the barren hill slopes; but the question I have to ask you is simply this—What on earth are these poor wretched forest tribes to do under the present system? They are forbidden to cultivate for fear of spoiling the forests. They are deprived of all honest employment whatever. They are absolutely forbidden to cut on their own account any green thing. And all forest produce is declared to belong to the Crown. I say again, what on earth are they to do? Surely it needs no great penetration to see that the situation is a clear *impasse*, a deadlock, an official *cul de sac*, and one that must lead to very serious consequences if powerful and effectual remedies be not applied.

"It is not too much to say that under the present *régime* of so-called scientific conservancy the treatment of these unfortunate forest tribes has been simply scandalous. They have been of late years systematically treated as though they were outcasts from society, and had no rights whatever, certainly none that can be pleaded against the all-powerful Ráj Sirkar. Thousands are said to have emigrated to the neighbouring Native States to avoid the oppressive treatment to which they are now subjected in British territory; but unfortunately even there the ubiquitous Government official is able to pursue them, and bitter complaint is made that pressure is now habitually brought to bear on Native States to oblige them to adopt the very system which is doing so much injury in British territory. Where, I ask, is this wonderful and ever-widening circle of oppression to end?

"If it be necessary to ruin the forest tribes in British territory by converting into State forest every acre of unoccupied land that the Forest Department can seize, by prohibiting all cultivation in forest limits, by expelling the villagers from their homes, by appropriating the mowhra, by placing an embargo on toddy, by claiming as Crown property everything that grows or is produced on God's earth—why, Sir, I ask is it necessary to extend this iniquitous and outrageous system to the neighbouring Native States, which are gradually coming to be regarded as havens of refuge against British oppression.

"Now, this story, strange as it may seem, and bad as it is, is unhappily no new story. The main features of it have been for many years past a stock subject of controversy between the forest officials and district officers, and have been more than once brought into public notice—notably in an able paper entitled 'Persecution in the Western Ghâts,' by a well-known member of the Bombay Civil Service, in the pages of the *Calcutta Review*. But as long as Government are pleased to place their conscience in the keeping of the Forest and Abkari Departments, so long there is very great fear, nay certainty, that these miserable forest tribes will go to the wall.

"The letters from forest officers recently published in your columns clearly show the spirit in which this important question is regarded by the officials of the Forest Department. You will doubtless call to mind in this connection the extraordinary letter of 'Forests' which you published not very long ago. The next suggestion which appear-

ed was, if I remember right, one from a correspondent who called himself 'Viator,' who charitably expressed the view that the forest tribes were an anachronism and ought to be exterminated;—not, he was pleased to say, by fire and sword, but apparently by bag and baggage deportation from their own homes, while the young Bhils and Varlis he proposed to treat like young panther cubs, confine them in iron cages with a chain round their leg.

"While sentiments like these are freely advocated in the public press, and while the forest tribes are openly treated in the manner described in this letter, it is surely high time for some one to say a word on their behalf. These poor wretched devils have no *vates sacer*, no public or recognised protector to sing their griefs and joys and to urge their rights before these omnivorous and insatiable departments; but it may not be out of place occasionally to remember that Dublas and Varlis are God's creatures and British subjects, and are entitled, as such, to ordinary humanity and to common justice."

Thus according to the *Bombay Gazette*, great hardship exists among the forest tribes owing to the new conservancy rules now enforced in portions of the Bombay Presidency. Driven into their mountain homes by the Aryan invasion, these tribes are mostly aboriginal, and while successive waves of conquest have swept over Hindustan, they have peaceably remained in undisturbed possession of the jungle, and their rights to the free use of its produce. "Bhugut" takes up their tale of woe, and in picturesque language describes the treatment of these "poor wretched devils" as simply scandalous; he says that the situation is a deadlock, an official *cul de sac*, and one that must lead to serious consequences before long. The Forest Department appears to be exceedingly unpopular, and has arrayed against it the whole staff of the civil administrators of the country.

There is clearly something radically wrong when such things be, and we would ask some of our brethren in the Bombay Presidency to explain the circumstances more fully, and indeed to defend the serious charges brought against them. One cause of the mischief appears to be the numerical inadequacy of the staff of the Forest Department, the disproportion between the thousands of square miles to be overlooked and administered, and the mere handful of officers charged with this duty being so great as to render effective protection impossible; but it is probable that the application of hard-and-fast rules in a manner not always judicious is an important factor in the case. Who will enlighten us on the subject?

Several letters have appeared in the *Bombay Gazette* in answer to "Bhugut's" indictment, neither of them written by Forest officers. One signed "Fidelis" points out the probability of privileges granted to the forest tribes being abused, people living in trade centres receiving produce gratis under cover of passes, held by the tribes in the forest. He reminds his readers that the great difficulty in dealing with forest privileges is to

ensure the full enjoyment of the privileges by those for whose benefit alone they are granted, while preventing abuse by outsiders who have no claim to such consideration.

The other writer, "Decentraliser," cannot be said to throw much light on the discussion, but he makes one point, when he says that it is the very preservation of the forest tracts which gives these tribes their only means of subsistence, that were it not for the protection of these domains under the forest rules the advancing tide of civilisation would have sooner or later annihilated them. This is no doubt true if the land is capable of cultivation, and accessible; but if these forest tracts are situated, for instance, on trap hills similar to those found in the Central Provinces, then it would be many generations before the wave of civilisation would reach them.

Another letter by "Shams-ud-din," who is also not a Forest officer, asserts that "Bhugut" only deals with generalities, and misleads the public by making assertions which may be true concerning the Forest Department's treatment of a small section of the large forest population which he treats as a whole. We give the following extracts from "Shams-ud-din's" letter:—

"Mind, I do not admit that his statements are really accurate for any tribe or locality whatever. With a special knowledge of the desire and endeavours of Government always to conciliate the jungle tribes, I cannot believe in the wholesale confiscation of which 'Bhugut' writes. I know that over very large areas it has not been effected.

"In the second place, 'Bhugut,' confident in the knowledge that he is taking the fashionable side, shows a decided animus against the 'omnivorous department.' And, thirdly, 'Bhugut' is entirely wanting in imagination, in the faculty of putting himself in the wild man's place. Like Mr. Wilfred Blunt, he harps on the evidences among his clients of a very low standard of living.

* * * * * *

"I beg to say that I am not an officer of the Forest Department, and that in many respects its management appears to me, as to others, grasping, stingy, and faulty. But the criticisms that are passed upon it by people who will not take the trouble to master the difficulties of its task, besides being misleading and unfair, are likely to prove mischievous. Do you, Sir, or can anyone imagine that it is possible to introduce forest conservancy without creating a great deal of discontent. With the unrestricted use of the jungles a great many wasteful habits have been handed down to the people of to-day, not the wild tribes only. It is absolutely necessary in the interests of the country that these wasteful habits should be checked and confined in area. Some must be eradicated. Discontent there must inevitably be, and not of the wild tribes only. But in this, as in the mowhra controversy, they are a convenient peg on which to hang the agitation. My own observation leads me to the belief that the restrictions tell more hardly on the settled cultivators than on the wild tribes. The statement that the latter will be apt sooner or latter to assert what they

consider to be their rights in a very awkward and indiscriminating fashion covers a good large field. 'Bhugut' would consider it proved if they looted a Bania or knocked a Forest Guard on the head in a private quarrel. As a matter of fact, the wilder the people of Western India the easier they are to manage by the average Englishman fond of sport and with a kindly feeling for such as are poor and simple and ignorant. Of course in these days of constitutional agitation, and in a country where agitation, constitutional or other, is likely to be, and, if I mistake not, has been already, more than once, stirred up by people who keep themselves carefully under cover, the wild man may be utilised; but no spontaneous efforts to assert supposed rights need be feared as long as the forest and district officers exercise a little sympathetic care and tact, and are liberal in matters not essential to the growth of trees over the areas which Government may place in their hands after due deliberation."

"Shams-ud-din" has been replied to by "Jago," whose letter we reproduce :—

To the Editor of the "Bombay Gazette."

"SIR,—'Shams-ud-din,' in your issue of this morning, asks, 'Do you, Sir, or can any one, imagine that it is possible to introduce forest conservancy without creating a great deal of discontent ?' and observes, 'With the unrestricted use of the jungles, a great many wasteful habits have been handed down to the people of to-day, not the wild tribes only. It is absolutely necessary, in the interests of the country, that these wasteful habits should be checked,' &c.

"This is always the strain of the apologists of high-handed or rough-shod forest conservancy; but can it bear a moment's scrutiny? 'Shams-ud-din' takes 'Bhugut' to task for his generalities; but what is the above but a string of similar generalities? If people with 'many wasteful habits' have had 'unrestricted use of the jungles' to this day, it is a wonder any forests were left and no fuel or wood famine was caused all this time, and in fact till the scientific 'forest kings' were recently installed. The fact is, that the Indian people, whether wild or civilised, have an instinctive desire for the preservation of their trees as much as their cows, consuming only the products in each case; and if this feeling is giving way to a desire to cut and chop as opportunity offers, it is because the new policy of 'conservation' leads them to apprehend that they will not be allowed the benefit of their abstinence as heretofore. And as no conservancy can succeed in the face of a whole people inspired with such a distrustful and hostile attitude, the radical conservators ought, in the interests of the very cause they profess so warmly to advance, to shape their policy on less hard-hearted lines.

"But it is 'in the interests of the country' that they demand a check in these wasteful habits. It is admitted, however, that the people have had an unrestricted use of the jungles these many centuries, and if so it is clear they have a right to some compensation. If the interests of the country demand the invasion of that right, they should furnish the needful compensation.

"For the rest I leave 'Bhugut' to deal with 'Shams-ud-din' as he thinks best."

What we wish to see, is the whole question thoroughly examined and explained by a local Forest officer, and we trust that these lines may induce some one to take up the subject.

Whilst forest conservancy in the other provinces of India has been united harmoniously to the civil administration of the country, and in provinces like Bengal, the Central Provinces, Assam and Burmah, where jungle tribes have as many requirements from the forests as in Bombay, it has been found possible to demarcate immense areas of reserved forests free from rights without seriously interfering with the people ; yet forest conservancy in Bombay appears to have stirred up a strong opposition, so that even its supporters, as "Shams-ud-din," describe its management as "*grasping, stingy and faulty*."

Can it be that not content with control over well selected and compact reserved forests, forest management, with a view principally to revenue, is trying to control scattered forest tracts throughout the province, which the wisdom of Government in other provinces has abandoned to the people. But we have no knowledge of the Bombay forests, and must look to the officers of the department there for a clear statement of the case.

INDIAN FERNS.

In September or October 1882, I presented some specimens of Indian Ferns to the herbarium of the Forest School at Dehra, and I believe that Major Bailey invited the officers of his Circle to send me any rare ferns they might meet with. None, however, have yet reached me, except from Mr. J. C. McDonell, with whom I had previously been in communication on the subject. During the present year I wish to write for the *Indian Forester* a paper on the Ferns of North-Western India, the number of which, by the discoveries made by Mr. McDonell, Mr. Duthie, Mr. H. F. Blanford and the Messrs. Mackinnon of Mussoorie, has been considerably increased since the publication of Mr. C. B. Clarke's "Review of the Ferns of Northern India," which he contributed to the Transactions of the Linnæan Society in 1880. Since then Colonel Beddome's "Ferns of British India" has appeared, and though he has followed Mr. Clarke in most of his work, he differs from him stoutly in several instances. These differences among great authorities as to the specific existence and identity of certain ferns are due to two causes, *first*, to adherence to theory, to which observation is often made to yield, and *second*, to the fact that species are often determined and described merely from herbarium specimens, without the aid of observation and study in the field.

The theory I refer to seems to be that recently observed species, however apparently distinct, are likely to be mere varieties of previously known and described species, and it is very hard

work to convince botanists who go merely by herbarium specimens of the specific difference of a new fern. This theory is the result of reaction from the views of certain botanists, English and German, who have endeavoured to found numerous genera and species upon comparatively trifling differences, occasionally observed, but which are not always found, and which most other observers cannot recognise as being of importance. Thus Van den Bosch (!) made 24 genera and 450 species out of the two generally accepted genera *Hymenophyllum* and *Trichomanes*, which according to Baker contain only 80 and 92 species respectively. But to set down, as Baker does, *Nephrodium* (Lastrea) *elongatum*, of Hooker and Greville, a quadripinnatifid fern, and also *Nephrodium cochleatum*, Don, which is so distinct a fern as to have been made a separate genus by two different authors, as mere varieties of *Nephrodium* (Last.) *Filix-mas*, Rich., which is only bipinnatifid, and has a totally different appearance and habit, is really too much for any one who has been in the habit of observing these three ferns growing in their natural habitats. Even Clarke, who has made a loving study of the Ferns of Northern India *in situ*, is to me quite incomprehensible (or is it I that am incomprehensile?) on this subject of *Nephrodium Filix-mas* and its so-called varieties. He says that this fern, including its numerous Indian forms, is abundant in the Himalaya. But I am not sure that I have ever seen the British *N. Filix-mas* in India, unless some very small specimens in Kumaun; and if the typical plant is non-existent or very rare and very local, whence come the "numerous Indian forms." A "variety" must surely be a variation originating from a type, and not merely a separate species which one or more botanists, from a dislike to multiply species, choose to call a variety of a well-known species. Clarke's "Review" professes to be merely a copious appendix to Hooker and Baker's "Synopsis Filicum," and his plates are, he says, entirely supplementary to those of Colonel Beddome, and are not intended to be complete in themselves, but in many cases I find them to be only puzzling. I cannot make out where he places the most common Lastrea of Mussoorie, which to me appears a distinct species, and in no way to resemble *L. Filix-mas*. And only yesterday happening to be up at Landour I brought down what, judging from specimens formerly gathered in Kumaun, and others received from Sikkim, I believed to be the fern called by Clarke *L. Filix-mas, var. Schimperianum*, Hochst., and found it to agree with his description, but scarcely at all with his plate.

The object of this long digression is to show that there is still great room for study of the ferns of India; and I wish to point out that Forest officers, above all other persons, are well able to collect the data for this study. To what does Colonel Beddome chiefly owe his eminence as a Pteridologist, but to the opportunities he had as Conservator of Forests in Madras? Forest

officers have all, more or less, studied botany, and all are trained observers, and all are presumably fond of nature, or why have they joined the *jangalát* department? Forests as a rule are found in hilly tracts, and so are most species of ferns. Forest officers collect flowering plants, at least the arborescent and shrubby kinds, and some of them I believe endeavour to make complete collections of the *Flora* of their Divisions and ranges. Many of the phanerogamous plants are not a whit more important from a forest point of view than are the Filices or other cryptogamia, and as an Order the ferns are much more beautiful than many orders of the flowering plants. The beauty and interest of a fern is not dependent on the fleeting color of a flower; and the shape and often the color of a frond can be perfectly preserved in a herbarium specimen, whereas the most beautiful flowering plant when pressed often becomes an untidy and discolored mass. Putting scientific interest aside, therefore, although to the physiologist and histologist ferns indeed are of extreme interest, I maintain that to an ordinary mortal much more enjoyment can be got from the collection and study of a herbarium of ferns than from a herbarium of the flowering plants, and I would appeal to Forest officers not to ignore ferns, as I am afraid they as a rule do. Let them have fair play, that is all I ask for, and if the books, or the spare time necessary for the identification of the specimens collected be not at hand or wanting, there can be no difficulty in getting that done by others. A large number of specimens, if unmounted, can be sent through the post, packed between mill-boards and in wax cloth, for a trifling sum. I think it must be quite as interesting and important to know what species of ferns are associated with certain species of trees, and are generally found in certain kinds of forest, as it is to know how flowering plants are so associated, and I remember Dr. Brandis telling me that he studied and valued ferns in this connection. *Brainea insignis*, Hk., he instanced as characterising a certain kind of forest, I forget what. I see that Gamble, in his *Manual of Indian Timbers*, says that it is found in the pine forests of the Martaban Hills, at 4—6000 feet elevation. Mr. Gamble I believe never passes over a fern when collecting.

Not being a Forest officer, and consequently not having the opportunities and facilities for observing the rarer and more inaccessible ferns in their native haunts that I could desire, and no longer being so locomotive as I was when I began to collect ferns some 28 years ago, I am now dependent to some extent on the help of others. With the view, therefore, of adding to my collection and knowledge of the ferns of North-Western India, and so becoming better able to write the paper I propose to send to the *Indian Forester* I offer to examine, arrange, and name all ferns that may be sent to me, and in return I hope to be given such duplicates as my correspondents may be able to

spare. When desired, specimens will be faithfully returned as soon as I have examined them, or if the labels bear numbers I can send a list of the names. Also I should be glad to receive contributions of duplicates from Forest officers who are able to name their ferns for themselves. And I should be glad to exchange North-Western specimens for ferns from other parts of India.

From what I have said above it will be seen that I should particularly like to be favoured with specimens of *Nephrodiums*, both *Eunephrodiums* and *Lastreas*, and especially of *N. Filix-mas*, and its so-called varieties. *N. apiciflorum*, Hk., *N. Clarkei*, Hk. and Baker, *N. odentotoma*, Hk. and Baker, *N. rigidum*, Desv., *N. remotum*, Hk., I may also note as being among my desiderata. Another obscure group is the *Athyrium* section or sub-genus of the genus *Asplenium*, especially those species near *A. Filix-fæmina*, Bernh. Clarke says that the typical form of this species has not exactly been obtained in the Himalaya, and the Messrs. Mackinnon have pointed out that the common fern at Mussoorie, the fronds of which seem identical with the European *Filix-fæmina*, has a creeping rhizome instead of a tufted rootstock, and seems to be *A. Schimperi*, A. Br., an African fern, which Baker says differs from *A. Filix-fœmina* mainly by its wide-creeping rhizome. I should like to have all the *Athyriums* that can be sent to me.

To trained collectors, as Forest officers are, I need not mention that labels are required to authenticate specimens of plants. If the name of the fern is not known it should be left blank, but the approximate locality and altitude should be given, and the data and name of the collector, in order that the authority for the specimen may be quoted. The present season promises to be an early one, owing to the large amount of rain that has already fallen, on the outer face of the Himalaya at least, and if the rains are plentiful and well distributed this should be a good year for collecting. Already some of the larger ground ferns are springing vigorously, and have reached a good height. I should have mentioned above that discoveries of ferns new to the North-Western Himalaya are most likely to be made at high altitudes, and in deep valleys rarely visited by Europeans. The ferns along the known roads and tracks are pretty well-known. And a careful search on the trunks and branches of trees, not omitting the *coniferæ*, is likely to yield species worth collecting, of the genera *Davallia*, and *Polypodium*. A small pocket binocular field-glass is useful in such a search, or when examining cliffs and *khuds*. These epiphytal ferns must be gathered before the rains draw to a close, for they wither at once when the air gets dry. I need not add that notes about the specimens, or generally about ferns, will be very acceptable.

MUSSOORIE:
20th May, 1885.

C. W. HOPE.

Since writing the above I have observed in the *Indian Forester* for June a notable instance of the opportunities for observing and collecting ferns that present themselves to Forest officers, but alas! it is to be feared, an instance of a neglected opportunity. Mr. Bryant, in his interesting report on the Boxwood Forests of Kumaun and British Garhwál, says that "in the undergrowth, gigantic ferns, currants and raspberries, with dense and almost impenetrable thickets of ringal, render the task of inspection difficult and uncertain." "Gigantic ferns"! my curiosity and envy are roused, and I hope Mr. Bryant did secure specimens. But my hopes are faint, for he treats the ferns with scant courtesy. To be impartial, he ought to have mentioned only the Orders of the flowering plants in the undergrowth, *Rosaceæ*, *Saxifrageæ*, and *Gramineæ*, but he goes the length of naming the Genera, whereas the ferns are mentioned only by the Order. I may conjecture that *Gleichenia linearis*, Burm.,—which Mr. Clarke says is scandent over other jungle, sometimes for several hundred feet, often rooting,—was there, but these may have been other species not before known west of Nepál. Since I wrote the above appeal I have heard of the discovery within the limits of the Municipality of Mussoorie of a fern never before found in these Provinces, and hitherto known to exist in India only in two localities in Sikkim. Here is encouragement to keep one's eyes open.

30th June, 1885. C. W. H.

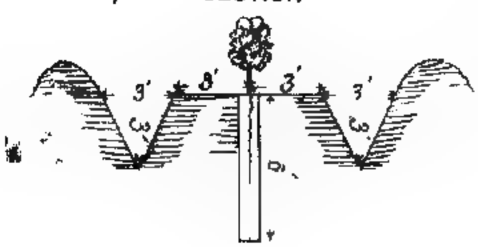
THE PLANTING OF ROADSIDE TREES.

I SHOULD like the opinions of my brother officers on the above arboricultural operation. When carrying out on a large scale, expense is a factor that has to be considerably taken into account.

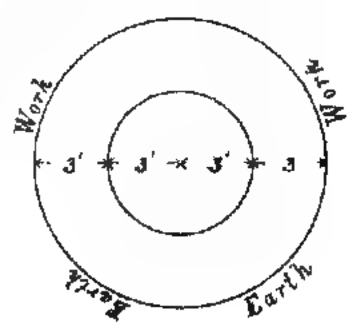
I have endeavoured to do away with some of the older and more expensive, but successful, methods, such as watering, patrolling establishment, brick walls, thorns and wooden fences.

The plan I have adopted hitherto is as follows :—

SECTION



GROUND PLAN



By planting out in "taolas" (there is no English or French equivalent of this word that I know of) —

	Rs.	A.	P.	
Cost	0	2	0	for the circular ditch;
	0	0	6	for a hole 6′ × 4″ × 4″;
	0	0	3	planting out;
	0	0	3	add cost in nursery per tree, with no other expenditure;
	0	3	0	

I find that cattle will not cross over a 3 feet ditch on to a platform only 3 feet broad.

Method of planting out.—A hole is dug 6′ × 4″ × 4″, this is half filled with rain water from the surrounding ditch, earth is filled in for about 2 feet, then the tap root of the seedling, about 4 feet in length, is lowered into the hole and filled up with earth. The object is to get the end of the root beyond the ball of earth, into cool soil, and as the water recedes for the root to follow (in soft soil for 2 feet) when the tree becomes established.

The drawbacks to this system are, that if left to natives in the rains without European supervision, they scamp the work, and charge for, but do not dig, the 6 feet holes. The result of this is, that the root being in the central ball of earth, in the following hot weather it gets baked, and the seedling often withers and dies, but this can be obviated by having the holes dug some months before, and inspected by the officer in charge. Again, if the subordinates employed break the tap root, and it does not get into cool soil, this is made manifest by their dying the following hot weather.

It is generally admitted (except perhaps by Major Campbell Walker) that we in the plains of India cannot cut off the tap roots as is often done with seedlings at home when digging out of the nursery, and it is generally allowed I think in this country, that trees do not make vigorous upward growth, until the tap root has gone down to a moist stratum, and is able to pump up its own water supply. I have known unwatered seedlings remain a few inches high for some years, and then to make several feet per annum. I have noticed also that windfalls as a rule have no tap root, or that the tap root has become rotten with age or other cause.

I have taken special precautions in the nursery to preserve the tap root, given to each tree by nature, but regarding this I intend addressing you later on in another letter.

ARBOR.

AMONGST THE SHANS.*

By Colquhoun.

We recommend every forest officer to obtain a copy of this interesting book. The Shans are a race but little known to Europeans, and Mr. Colquhoun deserves great praise for the energy he has shown in bringing the subject before the English public, and in advocating the construction of a railway from Bankok to Zimmé, the capital of the Shan States belonging to Siam, and then northwards through the Independent Shan States, which have just won their freedom from King Theebaw. It is also proposed to construct branch lines to Moulmein and Pegu. We are glad to see from the papers that the English Chambers of Commerce are taking up the question in earnest, and we hope before many years are past that the railway will be *un fait accompli*, and knowing from experience that the Shan is a trader by nature, we have every confidence in its commercial success.

The book is full of interest from the first chapter to the last, and we here give some quotations concerning forest matters, in the hopes that the reader will be induced to send for the book and read it in its entirety.

Between a place called Muang Haut on the Méping and the Salween, it appears that "the teak forests are nearly worked out, and the timber that is left is small and of poor quality. Notwithstanding the great rise in the value of teak of late years, it no longer pays the Burmese contractors whose fathers made fortunes in this district, to continue to work the forests. Every stick worth floating away has been recklessly cut down and removed. No fostering shelter has been left for the young trees, nor have any been replanted. In the nine principal forests hitherto worked—the Zimmé, Hmine Long-gyee, Thoungyeen Dahguin, Mé-gu Phonmezé, Naupa, Monepégyee and the Salween—but little remains worthy of extraction. Good forests still exist, notably that of Lagon, which lies south-east of Zimmé, and those in the neighbourhood of Kiang-Tsen." Further on it is stated that besides teak there is a large export of lac from Lagon, and that no less than 14,000 piculs, or 1,862,000 lbs., were sent to Bankok last year. Kiang-Tsen is admirably situated as a trade centre in an extensive plain surrounded by fine teak forests.

In describing the toungya system, Mr. Colquhoun says that it is the *bête noir* of the officers of the forest department. In the

* The Leadenhall Press, 1885.

Shan country in suitable localities an ingenious method is adopted in order to facilitate the clearance of the ground. The work of felling is commenced from the bottom of the hill slopes; the lower trees are only cut slightly on the upper side, the woodman, as he ascends the hill, cutting deeper and deeper until at last he completely fells the trees. In this way they fall on those below them, turn them over, and this continues to the bottom.

The dyes are of local manufacture, similar to those in use amongst the Burmese. Saffron is generally used for yellow, green is produced by dipping threads that have been dyed yellow in a boiling decoction of the leaves and twigs of the creeping *Marsdenia tinctoria*. Indigo which grows wild as well as in a cultivated state, is used for blue, the mordant being the bark of a kind of *Eugenia*. Stick-lac, the fruit of the tamarind and various woods give red. Jack, the root of a species of *Garcinia*, the flowers of the *Butea*, and the leaves of the *Memecylon*, give different tints of yellow. Black is produced from the *Diospyros Mollis*, *Terminalia Chebula* and *Jatropha Cuneas*. Orange from the seeds of *Bixa Orellana*.

Elephants are used throughout the Shan States and North Siam, not only for dragging timber, but for the carriage of all agricultural produce. At all towns we passed, it was a strange sight to see the number of elephants grazing together in the fields with the bullocks and buffaloes. Ten years previous to our visit, good elephants could be purchased for from three to four hundred rupees; but owing to the great demand for them in the teak forests and timber yards the price has risen to eight hundred and even a thousand.

The extensive grassy plains and the wooded country in Northern Siam form a great breeding ground for elephants, ponies and cattle, which are carried into British and Upper Burmah and there bartered for merchandise. In 1881 no less than 41,588 head of cattle and 1,322 ponies were imported into British Burmah alone from the Shan country. Its value as a cattle-breeding country for the cultivators of British Burmah cannot be too strongly insisted upon. The main staple of Burmah, and the backbone of our trade with that country, is rice; and for its cultivation a large number of cattle is an absolute necessity. Owing to the epidemics which frequently occur in Burmah the cultivation which has so greatly increased of late years, would have remained stationary or suffered serious decrease, had it not been for the source of supply in the Siamese Shan country. In 1866 upwards of 100,000 head of cattle—buffaloes and bullocks,—died of the disease in Burmah.

Siam is said to be a land-locked country without roads and bridges, with its rivers impracticable for any distance for large craft, owing to rapids, fierce currents and quicksands; it is very fertile and has a large population in the valley of the Ménam, and by no means a spare one in other parts; it contains about

260,000 square miles of territory, and is very rich in minerals and in teak forests, the great part of which is unworkable for want of good communications. Siam is the breeding ground for the elephants that are required for our military commissariat, our teak forests and our timber yards. Our teak forests and those of Upper Burmah are rapidly being exhausted, and many of our foresters are now working those of Siam. If the country is opened out by railways the large forests existing between the 17th and 22nd parallels of latitude will become easily available and be a valuable source of supply.

From the *Pioneer* we observe that Mr. Holt Hallett read a paper on the subject before the London Chamber of Commerce on the 13th of April, and that the meeting passed a unanimous resolution "to urge upon Her Majesty's Government the great importance of furthering in every way the establishment of railway communication from British Burmah towards the south-west frontier of China." Now although the Indian Government cannot be expected to guarantee the undertaking, yet it will probably be willing to further the object in view as much as possible, and we think it would materially assist the scheme by deputing one of its forest officers to accompany Mr. Colquhoun and the expedition which is about to make a rough survey of the proposed lines. The forest officer might report on all the forests along the line of route which would be tapped, or their timber-yielding capacity, on the quantity of timber which could be exported, on the best way to supply the railway with sleepers, fuel and other wood for its own use, in fact to give advice in all matters connected with his department.

III. Notes, Queries and Extracts.

On Friday night the House of Commons agreed, without a division, to a motion by Sir John Lubbock for a select committee to inquire whether, by the establishment of a forest school, our forests and woodlands could be rendered more remunerative. The proposer pointed out that, while our interests in the subject were greater than those of any other country in the world, as we had 2,800,000 acres under wood in Great Britain and about 840,000,000 in the Colonies, yet this was almost the only country without a forest school. He referred to the effect of scientific forestry in the Landes in France, and in India, where the net forest revenue fifteen years ago was only £52,000, while, since the establishment of a forest department, it had risen to over £400,000 per annum. As a result of neglect of the science in this country, students for India had to be trained at Nancy, a school of course specially adapted for French requirements, and the Forests in our Colonies and other possessions (Cyprus and the Cape, for example) had to be put under the control of foreigners, as there were no Englishmen trained for the work. Sir John Lubbock, however, declined to commit himself to the establishment of a Government school; it could not be left altogether to private enterprise, because a school necessarily required access to a considerable area of forest. He thought it worthy of consideration whether some intermediate system might be adopted which would enable some one or more existing institutions to benefit by national forests. Mr. Gladstone, whose interest in arboriculture is well known, could not bind the Government to the establishment of a School of Forestry, although he recognised the universal ignorance on the subject prevalent amongst land agents and others in England. He distinguished the circumstances in India, where there are important facts connected with the climate, and with the due supply of moisture in the atmosphere, which are not present in this country. The School of Forestry, moreover, he said, which was established by the Indian Government in England, was open to every one who could pay the fees. There was also the difficulty that forests of large extent are rare here, and that they are kept, not for purposes of profit, but of landscape beauty, or pleasure and sport. In conclusion, he said the Government gave their hearty approval to Sir John Lubbock's proposal, reserving, at the same time, their freedom with regard to the recommendations which the committee might make.—*Nature.*

Note.—We give the debate *verbatim* from the *Times* on the next page.—[Ed.]

DEBATE IN THE HOUSE OF COMMONS ON THE ESTABLISHMENT OF A SCHOOL OF FORESTRY.

Sir J. Lubbock rose to move for a Committee to inquire whether, by the establishment of a Forest School, our forests and woodlands could be rendered more remunerative. He said that, as last year he had the opportunity of addressing the House on the subject, he would not trespass long on their indulgence. The subject was one of considerable importance. England was almost the only country without a Forest School. Such institutions existed in Prussia, Saxony, Hanover, France, Switzerland, Austria, Sweden, Spain, Russia, and, in fact, in almost every other country. The need for a Forest School in England had by no means reference only to the State forests. There were some 2,800,000 acres under wood, while in the colonies the forests were estimated to cover no less than 840,000,000 acres. In fact, our interests in this respect were larger than those of any other country in the world. He would only give two instances out of many which might be quoted to show how much might be effected in this direction. Thirty years ago the Landes was one of the poorest and most wretched regions in France. It had been judiciously planted, and was now one of the most prosperous. The increase of value was estimated at no less than £40,000,000. In India 15 years ago the net forest revenue was only £52,000, while since the establishment of a Forest Department it had risen to over £400,000, which, of course, would represent an immense increase in capital value. Competent authorities had estimated that there were over 5,000,000 acres of land in this country which might be planted with advantage. M. Boppe, one of the greatest French authorities, had recently visited this country on behalf of the India Office, and clearly indicated his opinion, though he expressed it as courteously as possible, that we were behind other countries in the management of our woodlands. Our own highest authorities were of the same opinion. Mr. Brown, in his standard work on Forestry, said that—"If our woodlands had been judiciously managed we should not find so great a part of the woodlands of Great Britain in the unprofitable state in which they are." Mr. Cruikshank, in his "Practical Forester," said that "nothing was more common than to see trees planted in situations for which they were utterly unsuited," and he gave many illustrations. The *Journal of Horticulture* said that—"It is little less than deplorable to witness the miles of woods that are practically valueless from a commercial point of view, whereas, under skilled supervision, they might yield a substantial revenue to their owners, and in addition be an advantage to the trading and agricultural community." And the same view has been ably advocated by the *Journal of Forestry*. At a recent meeting of the Convention of Royal and Parliamentary Burghs of Scot-

land, held in Edinburgh on the 8th of April last, on the motion of the Lord Provost a unanimous resolution was adopted in support of the motion which he had the honor of moving. Indeed, so necessary was a scientific training that the officers intended for the Indian Forest Service were sent to study at Nancy. No doubt that was an admirable institution; but, naturally enough, it was specially adapted to French requirements. For instance, one of the subjects was French law; again, of course, French technical terms were used. The India Office proposed, he believed, that a part of the course should in future be passed at Cooper's hill, but that the students should spend some time in France to study the practical part. That, of course, was an acknowledgement, first, of the advantage to be derived from systematic training, and, secondly, that such advantage could not be procured in this country. He was informed that, the West Indies having recently applied to the Colonial Office for some one to advise them on their forest management, it had been impossible to find any person in this country competent to do so. The Cape of Good Hope and Cyprus had also been compelled to entrust their forests to foreigners. They were indebted to the honorable member for Dublin for several interesting reports on forest management; but he would leave his honorable friend to deal with them. The present was a favourable time for the inquiry, because Dr. Schlich, the head of the Indian Forest Service, was now in England, and, he believed, that this was also the case with his predecessor, Dr. Brandis. This was not a case, he thought, which could be left altogether to private enterprise, because a Forest School necessarily required access to a considerable area of forest. He did not, however, wish to commit himself to the establishment of a Government school; he thought it at least worthy of consideration whether some intermediate system might be adopted which would enable some one or more existing institutions to benefit by the national forests. At present, the landed interest was so greatly depressed that we ought not to neglect any step by which its condition might be improved. To show the demand for timber, he reminded the House that our annual import was about £16,000,000. He believed that the average income derived from woodlands might be substantially increased. Moreover, it was desirable that the whole question should be investigated, before the Government committed themselves to a new system of training for the Indian Forest officials. He trusted, therefore, that Her Majesty's Government would consider that he had made out a strong case, at any rate, for inquiry, and that the House would accede to his motion. In conclusion, he begged to move for a Select Committee to consider whether by the establishment of a Forest School or otherwise our woodlands could be rendered more remunerative. (Hear, hear.)

Dr. Lyons, in seconding the motion, reminded the House that

he had for some years past called attention to this subject in connexion with Ireland. It was, undoubtedly, the case that of late years a very considerable diminution had taken place in the amount of wood planted. Ireland had formerly been able to carry on a large amount of iron smelting by means of her wood, and the smelting had come to an end when the supply of wood had ceased. He had to thank the noble lord the Under-Secretary for Foreign Affairs and the noble lord the Secretary for the Colonies for the ready assistance which they had given him in investigating the important subject of forestry. In reports, which included the greater portion of Europe, it was clearly laid down that those countries could no longer afford to export an unlimited amount of timber to this country. It was the same with regard to the United States and to Canada, where the timber had been recklessly cut down, and where constant forest fires destroyed as much timber as would have supplied European demands for some years. The honorable member for London University had referred to our timber imports as amounting to £16,000,000. That return, he thought, must refer to timber alone, without other forest produce, such as tar, pitch, resin, and bark. The whole of the forest produce imported into this country really amounted to about £30,000,000. With regard to European countries, France was not in a position to supply all her own industrial wants, but was importing a large amount of timber every year. We must also look for a cessation of the timber supply from the Baltic in a very short time; the countries in that neighbourhood had lately been supplying small timber, which showed that they were cutting down miniature trees. There could be no doubt that one of the main economic causes which had hindered the progress of Ireland had been the destruction of her forests. The forests had been destroyed, partly in order to prevent the natives from sheltering there from their oppressors and partly for smelting purposes. The amount of woodland in Ireland was decreasing; there were now 45,000 acres less than in 1841. The total amount of timber now standing in Ireland was only 350,000 acres. How much this was below the amount of woodland Ireland ought to possess was seen from the fact that the best authorities had held that to keep a country in good order and insure the proper growth of crops from one-third to one-fourth ought to be protected by woodland. The amount of woodland possessed by Great Britain, though much larger in proportion than that of Ireland, was small compared with other countries. In Prussia there were 34,000,000 acres, in France 22,000,000 acres, in Austria, 23,000,000 acres, and in Hungary 22,000,000 acres of woodland. To the excellent management and cultivation of her forests he believed that the present prosperity of Hungary was in a great measure due. He had no hesitation in saying that the amount of timber in the British Empire was infinitely below what it ought to be for

the proper protection of the soil, the proper protection of flocks and herds, and for the general development of industry. At present a large amount of timber was imported into this country; if through war one single year's supply was stopped many industries would be ruined for years to come. How much might be done by the State for forestry was, he thought, shown by the conduct of our Indian Government. The Indian Forestry Department had saved the Indian forests from the destruction and devastation to which they were rapidly becoming a prey, and had made their administration financially and in every way a great success.

Sir H. Maxwell said they had re-afforested many of the barren hillsides of Scotland. He might instance the country of Inverness, which now contained 900,000 acres—he thought the largest, Yorkshire coming next. What were they to expect from the appointment of a Select Committee? The Prime Minister said little could be expected from a Committee at this period of the session. (Mr. Gladstone dissented.) Then he must have misunderstood him. An immense amount of information would be collected and placed at the disposal of the public. It might be asked what was the difference between forestry and horticulture that it should be encouraged by the State. There was this great difference—that forestry called for an amount of foresight, patience, and self-denial which was not required in any other agricultural pursuit. No one could fail to be distressed in going about the country to see thousands of acres of neglected woodland. They all knew that the present Prime Minister took a great deal of pleasure in connexion with arboriculture, and he trusted he would devote his energies to constructive as well as destructive operations. (Laughter.)

Mr. Gladstone.—I will answer the appeal of the honorable member, but I am sorry to say that I must accompany what I have got to say with a criticism. He says he hopes I will consent to add constructive to destructive arts in arboriculture. I should have hoped that the honorable gentleman would have been disposed to contend, as I am disposed to contend, that those who cut down trees are the only true conservators of our woods. (Cheers and laughter.) He says most truly that there is a multitude of ill-managed woods in this country, because of the superstition of their owners, which prevents them from properly thinning and clearing their woods. I confess that the principle is capable of very wide application, going far beyond the limits of the present debate, but I may contend that nothing does more to increase the ground of complaint with respect to the condition of our woods and plantations than that superstition which leads owners to think that it is a kind of sacrilege to cut down trees, instead of regarding it as the only way of keeping them properly. I agree that it is quite worth while to appoint this Committee, but I must make certain reservations. I do not

wish to be bound that the Government will establish a forestry school. I will give the reason why there should not be any foregone conclusion on that subject. My honorable friend who made this motion has spoken of the forestry schools which have been instituted abroad. That was quite true, but there are two observations to be made upon it. First, they have to depend on direct aid; and, secondly, the scale of operation is infinitely larger. I cannot agree with the honorable gentleman who said of the country of Inverness that there were 900,000 acres. I am convinced that there must be a complete error there. There can be nothing approaching to that in the county of Inverness—in fact, I think the whole amount in Scotland does not reach 900,000 acres.

Sir H. Maxwell said he might have been wrong about the figures, but Inverness was larger than any other county in the United Kingdom.

Mr. Gladstone.—I do not much contest that, but there are one or two other counties also very large.

Sir H. Maxwell thought the amount for Inverness was 400,000.

Mr. Gladstone.—I am afraid I cannot afford that. I think my honorable friend who introduced the motion said the total for England was 2,800,000 acres.

Sir J. Lubbock.—Including Scotland.

Mr. Gladstone.—I think there is room for improvement in the management of our woods. Everything is done almost at haphazard. There is no fixed tradition, no authority to assist them. It is remarkable that land agents, who, as a rule, are gentlemen of great intelligence, are very rarely found with any practical knowledge on this subject. We find them admirably qualified for every other department, but not in the least degree able to lend assistance on this subject. I have said that I wish to be quite free on the question of establishing schools, and I will mention one reason for this. Allusion has been made to the study of forestry in India, and eulogiums have been passed on the leading servants of the Indian Government connected with that interesting subject. The Indian Government have had most special reasons for giving attention to it. First of all, it was found impossible to make forestry profitable. I certainly do hope that this subject is in course of being dealt with satisfactorily in India. We must, however, recollect that there are important facts connected with the climate and with the due supply of moisture in the atmosphere in India which are not present in this country. The Indian Government has a school of forestry in India and also in England, and it should be known that the latter is not confined to the instruction of persons in India or contemplating residence in India. Any person who chooses to find the necessary fees for admission to the English school can receive instruction there. A great deal of difficulty in the way of studying forestry in this country arises

from the limited scale of operations which can be conducted here in consequence of our woods being broken up into such small areas. The number of properties on which there is a sufficient amount of wood to admit of large operations or of systematic training is not great. I myself have had a great deal to do in connexion with the forestry of one district, and that is certainly not a large one; and woods of 6,000 or 7,000 acres in extent are extremely rare in England. One great difficulty in the way of a proper culture of woods in this country arises from the fact of their being kept, not for the purposes of profit, but of landscape beauty, or pleasure and sport. (Hear, hear.) The interest which I take in this subject has caused me to pay particular attention to the way in which our woods are managed, and have led me to believe that we should gain a great deal if we were to have more common traditions upon the subject. (Hear, hear.) There are some parts of the midland counties where the art of wood cutting is practically unknown, and there are also many other parts of the country where scarcely any one knows how to cut down a tree. (Cheers and laughter.) That is the result of a general want of attention to the subject. I think that great utility would result from the inquiries of this Commission. I do not think that the honorable member who has just sat down quite understood what I said yesterday with regard to the appointment of Select Committees at this period of the session. What I did say was that it was unadvisable at this period of the session to appoint a Select Committee to conduct inquiries which could not produce satisfactory results; but as regards the Select Committee now asked for, the honorable member who asked for it has shown in the first place that there are satisfactory reasons for its appointment at this time, and although its labours might be for a time interrupted by the dissolution, yet a valuable partial inquiry might be made during this session and taken up and carried further in a future session. (Hear, hear.) Therefore, reserving to ourselves our freedom of opinion with regard to the recommendations which such a Committee may make, I may say that we give our hearty approval to the proposal of the honorable member, and sincerely hope that great benefits may result to the country from the inquiries which the Committee may make. (Hear, hear).

Sir W. Barttelot said that this important question had been greatly neglected in this country. Few men knew how to thin a plantation, and scarcely two would agree as to the proper time when the thinning should take place. It was on this account that our plantations in England had suffered so severely. He agreed entirely with the right honorable gentleman opposite as to the area of land under woods in this country. He did not think that anything like the area was under wood which had been stated by some honorable members. In the eastern division of

Sussex they had turned their attention towards the cultivation of undergrowth and underwood with the result that they found employment for large numbers of people during the winter months. (Hear, hear.) In pursuing this course, however, they could not shut their eyes to the fact that the value of this underwood and timber had greatly depreciated, and it would not be until there was a diminution of the supply from abroad that the value of timber in this country would rise to a fair level. He was informed, however, that nearly all the timber near the watercourses of America, from Italy and Spain, had been cut, and there was but little chance of many large supplies reaching us in the future from those countries. He therefore hoped that we in this country should not neglect planting timber which would grow fairly well on land that was not good for agricultural purposes. He believed that this Committee would do a great deal of good, and he should be glad if one of the results of the inquiry was to teach young men the art of cultivating timber. As it was, there was considerable difficulty in getting men to manage woods properly. (Hear, hear.)

Dr. Farquharson was glad to hear from the right honorable gentleman that at length forest culture was to be placed in this country upon a satisfactory basis. In England a most haphazard mode of planting had been pursued for a long time. A great deal of waste land had been made use of for agricultural purposes, for which it was altogether unfitted, whereas it would have done admirably for planting trees. Where the planting of trees was properly carried out their culture paid admirably. He trusted that in future years it would not be necessary to have recourse to foreign schools of forestry, but that an efficient school would be established in this country.

Mr. Dawson thought the question might serviceably be brought before the Committee on Irish Industries, as there was no part of the United Kingdom where improved methods of forestry would be of more advantage than in Ireland. The honorable member for Dublin, who had made himself remarkble by devotion to this question, had dealt instructively with many branches of the subject, but there was one to which he had not referred. In the Black Forest and in Switzerland the young people were profitably employed in making the thousands of toys which were imported into this country. There was no reason why many thousands of our unemployed and starving population might not find the means of subsistence in this industry. The Prime Minister had deprecated the interference of the State, but the State had in Holland reclaimed the land from the sea, and here at home was expending its resources in teaching many subjects to the children of the poor, which, from a wage-earning point of view, were absolutely useless. (Hear, hear.) It would be much wiser that children should receive good technical training in the trades by which they were to make their living. (Hear, hear.)

Sir G. Campbell thought one had no need to go further than Kensington gardens to see what a lamentable want existed of scientfic forestry in this country. He agreed that the Indian Forestry Department had done good work, but he was inclined to think that it had been a little overpraised, as there was a great want of scientific method in the system which it pursued.

Mr. Ackers said that subject was one in which the three kingdoms were equally interested. There was no good school of forestry in the country, and the art of forestry might be said to be absolutely unknown. Similar treatment was apparently applied to all trees alike, and it did not appear to be known that what was good for one tree killed another. While agreeing with the Prime Minister that there should be no foregone conclusion, he hoped the matter would not be entered upon with the idea that a school of forestry was not necessary, and that Government assistance should not be given to it.

Sir J. Lubbock's motion was then agreed to.

CHINESE INSECT-WHITE WAX.—A parliamentary paper which has recently been published (China, No. 2, 1885) contains a report of a journey through Central Sze-chu'an, which was made by Mr. Hosie, Consular Agent at Chung-king, chiefly for the purpose of collecting information on the subject of insect-white wax, specimens of the insect wax-trees, and forms of the wax product, at the request of Sir Joseph Hooker. The report describes the country traversed, its trade and trading capabilities, and such information as was attainable on any commercial product of the district; but the portion relating to insect-white wax is the most interesting part of the paper.

"Insect tree" is the name given by the Chinese in the extreme west of Sze-chu'an to what is probably the *Ligustrum lucidum* of botanists. The point will doubtless be decided at Kew by the specimens which Mr. Hosie has sent home. It is also called the winter-green or evergreen tree; while in the east of the province it is known as the "crackling flea tree," owing, it is said, to the sputtering of the wood when burned. It is an evergreen, with leaves which spring in pairs from the branches. They are thick, dark green, glossy, ovate, and pointed. In the end of May or beginning of June the tree bears clusters of small white flowers, which give place to small seeds of a dark blue colour. In the month of May, 1883, Mr. Hosie found attached to the bark of the boughs and twigs numerous brown pea-shaped excrescences or galls, in various stages of development. In the earlier stages they looked like minute univalves clinging to the bark. The larger galls were readily detachable, and, when opened, presented either a whitey-brown pulpy mass, or a crowd of minute animals, whose movements were only just perceptible to the naked eye. Last year an

opportunity of examining these galls and their contents with some minuteness in the chief wax-producing locality in the province presented itself. They are very brittle, and there was found, on opening them, a swarm of brown creatures, like minute lice, each with six legs and a pair of club *antennæ*, crawling about. The great majority of the galls also contained either a small white bag or cocoon, containing a chrysalis, whose movements were visible through the thin covering, or a small black beetle. This beetle also has six legs, and is provided with a long proboscis, armed with a pair of pincers. It is called by the Chinese the "buffalo," probably from its ungainly appearance. After a few days it turned out that each chrysalis developed into a black beetle, or "buffalo." If left undisturbed in the broken gall, the beetle will, heedless of the wax insects, which begin to crawl outside and inside the gall, continue to burrow with his proboscis and pincers in the inner lining of the gall, which is apparently his food. The Chinese believe that he eats his minute companions in the gall, or at any rate injures them with the pressure of his heavy body, and galls in which beetles are numerous sell cheaper than others. But careful investigation showed that the beetle does not eat the other insects, and that his purpose within the gall is a more useful one. When a gall is plucked from the insect tree an orifice is disclosed where it was attached to the bark. By this the wax insects escape. But if the gall remained attached to the tree no mode of escape would appear to be provided for them. The beetle provides this mode. With his pincers he gradually bores a hole in the covering of the gall, which is of sufficient size to allow him to escape from his imprisonment, and which allows egress at the same time to the wax insects. When the beetles were removed from the galls some of them made efforts to fly; but at that time their *elytræ* were not sufficiently developed, and they had to content themselves with crawling, a movement which, owing to the long proboscis, they performed very clumsily. Through the orifice thus created by the beetle the insects escape to the branches of the tree, if the gall be not plucked soon enough. When plucked the galls are carried in headlong flight by bearers who travel through the night for coolness to the market towns, and every endeavour is made to preserve a cool temperature in order that the heat may not force the insects to escape from the galls during the journey.

The wax-tree is usually a stump, varying from three or four to a dozen feet in height, with numerous sprouts or branches rising from the gnarled top of the stem. The leaves spring in pairs from the branches. They are light green, ovate, pointed, serrated, and deciduous. The branches are rarely found more than 6 feet in length, as those on which the wax is produced are cut from the stems with it. The sprouts of one and two years' growth are too pliant, and it is only in the third year,

when they are again sufficiently strong to resist the wind, that wax insects are placed on them. In June some of the trees bear bunches apparently of seeds in small pods, and specimens of these have been sent to Kew.

The wax insects are transferred to these trees about the beginning of May. They are made into small packets of twenty or thirty galls, which are inclosed in a leaf of the wood-oil tree, the edges of which are fastened together with rice-straw. These small packets are then suspended close to the branches under which they hang. A few rough holes are made in the leaf by means of a large needle, so that the insects may find their way through them to the branches. On emerging from the galls the insects creep rapidly up the branches to the leaves, where they remain for thirteen days, until their mouths and limbs are strong. During this period they are said to moult, casting off "a hairy garment," which has grown in this short time. They then descend to the tender branches, on the under sides of which they fix themselves to the bark by their mouths. Gradually the upper surfaces of the branches are also dotted with the insects. They are said not to move from the spots to which they attach themselves. The Chinese idea is that they live on dew, and that the wax perspires from the bodies of the insects. The specimens of the branches encrusted with wax show that the insects construct a series of galleries stretching from the bark to the outer surface of the wax. At an early stage of wax production an insect, called by the Chinese the "wax-dog," is developed. Mr. Hosie was unable to obtain a specimen of this insect, but it was described to him as a caterpillar, in size and appearance like a brown bean. His theory (which, he confesses, is unsupported by outside evidence) is that the female of the "buffalo" beetle, already mentioned, deposits eggs on the boughs of the insect tree or the wax-tree, as the case may be, and that the "wax-dog" is the offspring of the buffalo. There may possibly be a connection between this caterpillar and the gall containing the wax insects. It is said that during the night and early morning the insects relax their hold of the bark, and that during the heat of the day they again take firm hold of it. The owners of trees are in the habit, during the first month, of belabouring the trees with thick clubs to shake off the "wax-dog," which, they assert, destroys the wax insects. After this period the branches are coated with wax, and the "wax-dog" is consequently unable to reach his prey. The first appearance of wax in the boughs and twigs has been likened to a coating of sulphate of quinine. This gradually becomes thicker, until, after a period of from ninety to a hundred days, the wax in good years has attained a thickness of about a quarter of an inch. When the wax is ready, the branches are lopped off, and as much of the wax as possible is removed by hand. This is placed in an iron pot with water, and the wax, rising to the

surface at melting-point, is skimmed off and placed in round moulds, whence it emerges as the white wax of commerce. The wax which cannot be removed by hand is placed with the twigs in a pot with water, and the same process is gone through. This latter is less white and of an inferior quality. But the Chinese, with their usual carefulness that nothing be lost or wasted, take the insects, which have meantime sunk to the bottom of the pot, and, placing them in a bag, squeeze them until they have given up the last drop of the wax. They finish their short, industrious existence by being thrown to the pigs. The market price of the wax is about 1*s.* 6*d.* per pound. It is used chiefly in the manufacture of candles. It melts at 160° F., while tallow melts at about 95°. In Sze-chu'an it is mixed with tallow to give the latter greater consistency, and candles, when made, are dipped in melted white wax to give them a harder sheathing and to prevent the tallow from running over when they are lighted.—*Nature.*

CHINESE INSECT WAX.—The beetle alluded to in connection with this subject in the last number of *Nature*, (Vol. xxxi, page 615) is a probably undescribed species of *Brachytarsus*, a genus of the family *Anthribidæ*, allied to the *Curculionidæ*. Through the courtesy of the authorities at Kew I have had specimens before me. The idea that it acts as a sort of midwife to assist at the birth of infant *Coccidæ* is quite erroneous. The genus *Brachytarsus* is a true parasite on *Coccus*, and its habits, in this connection, in Europe, have long been known. It is of course interesting to find "unity of habit" prevailing in the case of *Coccus Pé-la*, even to its parasite; but with regard to the latter there is nothing new; some points in the general economy of the wax insect, in the notes published, are of far greater importance. R. MCLACHLAN.—*Nature.*

NOTES ON THE FLORA OF THE MURGHAB VALLEY.—The following notes by our botanist, Dr. Aitchison, on the country between Khusan and this may be of interest to some of your readers.

At Khusan the village was surrounded with enclosures of low mud walls, and along the sides of these walls, which were some 4 feet or more in height, were planted a row of mulberry trees. These were treated as pollards, and from the annual shoots that spring from the main stem are collected the leaves for feeding silkworms. These numerous mulberry trees point to the fact that silk culture is one of the industries of the place. The open spaces within the walled enclosures are chiefly devoted to the cultivation of lucerne, cotton, melons, and the castor oil plant, the last for its seeds, from which an oil is extracted for

burning and not employed as a medicine, although the seed itself is used medicinally.

Some small orchards of apricots and apples were noticed, with a few trees of eloëagnus, cultivated for its scented flowers as well as fruit, and a zizphus, this yielding the well know "unáb." Over graves and holy places a specimen of ash was common; one tree measured nearly 11 feet in circumference, but it branched soon and was only some 20 feet in height. A few shrubs of a garden-rose were seen, the first since leaving Quetta. White beetroot, turnips, and onions are the common vegetables to be got at this time of the year, all good in their way. Among rubbish heaps in the vicinity of the village, stramonium, known to be poisonous, occurred. Bees are unknown here, honey being imported from Persia. Much land was under cultivation and all assisted by irrigation. The banks of the river were covered with a good forest of the Euphratic poplar, the trees large, from 6 feet to 9 feet in circumference, and yielding fair-sized timber; on the margin of the stream tamarisk and a tall grass formed, with young poplars, a dense undergrowth in which numerous wild pigs of great size resort. The surrounding hills were devoid even of scrub, and looked bare and bleak, but upon closer inspection were found to be covered with the remains of grasses and plants, of which the stems had died down during the winter, and in many places the slopes were characterized remarkably by the still standing stems of the assafœtida and of another similar umbelliferous plant that yields an aromatic gum resin. These stems appeared as so many bamboo staves stuck irregularly into the ground, their branches having been long ago blown off, and many were spread prostrate by the prevailing winds.

The country between Khusan and the ascent to the Chashma Sabz Pass was extremely analogous to that we had passed over before reaching Khusan, with the exception that we came across a very curious bee-like, hairy fly, that irritated the horses excessively by entering their nostrils. Some specimens of which were collected with great difficulty. In the ascent on to the path a species of thorny amygdalus formed a dense, woody shrub of from 4 feet to 6 feet. Here the country was one great sheet of grass and remained so for several marches. On the pass itself, at an altitude of some feet, a rhubarb, a tall polygonum, and a species of eremurus covered the northern slopes, and as the descent was being made come good-sized trees of juniper were seen in the deep ravines where water was present, and in its vicinity a hawthorn, a cotoneasta, a wild eleagnus, a tree willow, with an extensively scrambling bramble, formed a dense impassable thicket. From the base of these hills to Bala Murghab the country seemed to consist of a sea of rounded sand-like hills that were crowded with what appeared to be solely the remains of a great prairie of grass, without showing the signs of any form of scrub; but during the summer there can be no doubt that many plants

exist which at present cannot be seen owing to their stems having withered down early. At Karobagh, and for several marches further on, the camp followers dug out great living roots of several plants, but chiefly of a species of liquorice for eating, employing it as tooth brushes and as fuel; they burnt fairly well although green and fresh. Though an occasional tree or a few clumps were seen of pistachio, the nut of which is so largely exported to India, only first did the route of the camp lie through a continuous forest of this tree in marching between Kodja Kalandar and Karez Darra; it occurs to a greater or less extent through the hills to the immediate vicinity of the Murghab river. The tree at this time of the year is extremely characteristic. Owing to its at present being devoid of leaves the branches give a local gray stone-like colouring to the otherwise bare hills, and at a distance, where the forest is dense, the hills look as if seen through smoke. These natural forests of the pistachio give the name of Pistalik to these parts, as the eleagnus does to the Jigdalik Pass, where it was once very numerous. The exportation of the nuts for food, as well as of the galls from the leaves of the tree for the purposes of dyeing, yields a revenue to the country, which is collected before the harvest is allowed to be removed by the nomad tribes. In the higher hills towards Herat and eastwards for 6,000 feet and upwards the juniper forms a thin forest, chiefly on the northern slopes, and there is said to be no other pine on these ranges.

In a deep valley, at about 5,000 feet, some few miles to the south of Karez Darra, a maple, willow, wild-pear, hawthorn, eleagnus, and a stout woody berberis were found. In the vicinity of a village close to this some very large cultivated pear trees were seen, with a jungle of zizphus, as if of natural formation; but here the tree may have spread from cultivation.

At present the whole land from Khusan to the valley of the Murghab is one great pastoral country, covered with flocks of almost unlimited number, their number being limited only by the absence or difficulty of getting water. Where sheep do not cover the ground, deer in thousands, wild donkeys, and oorial are said to be innumerable. The soil is excessively rich and the hills are all covered with—indeed, consist of—a very rich alluvial deposit, so much so that it is said by the inhabitants to yield a hundredfold.

The ruins of very extensive canals for irrigation are still to be traced on every hillside, with scarcely an exception, showing how largely the country had been once irrigated, and how since those days in many instances the hills had actually worn down to their present condition. There can be no doubt but that with peace and labour this country would rapidly prove a most fertile one, and would become rapidly populated. Even within the last two or three years, since the Turcomans have been prevented from making their usual raids, villages have sprung up and cultiva-

tion has been renewed in what has been for a time (in one sense) a desert.—*Pioneer*.

CEARA RUBBER (*Manihot Glaziovii*) IN THE KULSI PLANTATION, KAMRUP, ASSAM.—A small quantity of Ceara Rubber seed was received in June 1879, and sown on the 25th of that month on a seed bed situated on the spur of a hill facing the east. The soil of this spur is very deep, being composed of a brown or reddish loam mixed with a portion of clay. The consistency of the soil is neither very stiff nor very loose, but moderate. In appearance it is somewhat like the laterite soil of Eng forest in Burmah, or of the ferruginous soil of the Sivalik hills. The hill *from which the above spur projects is situated on the right bank* of the Kulsi river, which, issuing from the Khasia hills, joins the Brahmaputra at an equal distance between Gauhati and Goalpara. Teak plantations of some 8 or 9 years' standing cover the hill alluded to above. On the extreme end of this spur, which terminates rather abruptly in the Kulsi river, is erected a beautiful bungalow for the accommodation of the Forest officer. This bungalow faces the south, and commands an extensive view, covering some miles, of the Kulsi valley. The site selected for the nursery of the Ceara Rubber is protected on the two sides, north and west, by the range of hills which run almost parallel to the Kulsi river. Thus the violent north-westerly winds, which blow with much force for many months of the year, have less effect on the nursery bed than would have been the case had it been situated on some other open place. The climate of this place may be said to be semi-tropical. The rain commences from the middle or end of April, and lasts till the beginning of November. The average rain fall is 78 inches, and the average temperature is about 70° Fahr.

The seed was sent for an experiment to ascertain whether this plant, whose native home is at Ceara in Brazil, would grow as well in Assam, the climate of which place is said to resemble that of the Ceara district. As stated elsewhere, the seed was sown on the 25th of June, but nothing came out till the end of September, when only two or three seeds germinated. The seed is very hard, harder than a plumstone. It is about the size of a small bean. Its vitality is wonderful. The seed sown in June 1879 was taken out from the nursery bed in March 1881 without being injured or decayed; and one of them left in the bed germinated in July 1882, after being for over three years in the ground. Some of the seeds thus taken were filed in order to hasten their germination, if possible, while the rest were soaked in a weak solution of sulphuric acid and water for a day. They were sown again after undergoing the above processes separately in two beds. Of those which were filed only two germinated within a fortnight, but none of those steeped

in sulphuric acid and water. This simple fact decided Mr. Mein, the divisional Forest officer, to adopt the method of filing the Ceara Rubber seed before sowing it, and it has acted admirably well in respect of easy germination. Before experience was gained on the subject, the seeds were filed sometimes on the top, at right angles to its longitudinal axis, thus increasing the aperture of the hilum or microphyle, and sometimes on the two sides of the hilum securing the hard testa so that it may easily burst at the time of germination. The second system was very successful while the first system failed altogether. Thus by the second system all the seeds germinated within from 14 to 44 days.

The young seedling with the two cotyledonary leaves looks like the castor-oil plant, but soon after, when more leaves come out, its appearance changes, and the plant is sometimes mistaken for a Papua seedling, for its juice resembles that of the Papua plant. When the seedlings are 9 inches or 1 foot in height they are transplanted in suitable localities, and are well fenced, lest the deer should take a fancy to them. As regards locality, perfect drainage of the soil and subsoil is essentially necessary for the cultivation of this plant. It also prefers open high ground and hill-sides to shady or low-lying grounds. The growth of this plant is wonderfully rapid. The two seedlings which came up in September 1879 were found, when measured on the 16th June, 1880, to be 6 feet and 3 feet in height respectively, and in May of the following year 21 feet 9 inches and 14 feet, so that one of them has grown over 1 foot per month. Another plant on measurement after six months from date of germination was found to be 19 feet in height. It is a very soft-wooded tree, and requires strong wooden posts for support. The tree will probably coppice well. One small plant was broken to the ground by a violent storm, and the stool, after a few days, had been noticed to throw out fine and vigorous shoots. It can be easily propagated by cuttings, since some of the branches were cut and planted out with a view to propagate it, and they were seen to sprout. In the Kulsi plantation, there are now probably 150 plants from 4 to 40 feet in height. Their girths vary from 2 to 20 feet. Here the trees begin to lose their leaves in January, and remain leafless for more than a month. At that time they very much resemble in appearance a birch tree, and the surface of the bark comes off in the same way in their peelings. The seed-bearing trees are the last to put forth leaves, and this they do when all the seeds have fallen to the ground. The two biggest trees seeded profusely during the past two years. They commence to flower in the beginning of December, and the seed ripens by the beginning of March. The bunches of ripe fruit remain on the tree while it is leafless. The pod when ripe bursts, and goes to pieces, so that the seeds are scattered on the ground at some distance from the parent tree.—JOGESWAR SEN. —*Indian Agriculturist.*

THE WEIGHT OF AN AXE.—I well remember my first axe, and my early experience with it. It weighed 4½ lbs., being the heaviest one I could find at the time. I was fresh from school—fresh from a class in natural philosophy, one of my favourite studies.

I knew all about *inertia*, and had learned something of the force of gravity and the laws of falling bodies; had rightly guessed that chopping wood might be hard work, and determined that my knowledge of physics should help me out.

I would have a heavy axe, a long handle—would move slowly, and take strokes that would *count* when they fell. My axe-handle was 34 inches in length, the longest one in the store. I had hired a tough little French Canadian, weighing about 120 lbs., to help me at this work. When he came, he brought an axe—a mere toy, I call it. I think it weighed 2½ lbs., with a handle only 26 inches long. I told him I had a fair-size job for him, and thought it would pay him to buy a full-grown axe. He smiled, and said he guessed his would do. I tried to explain to him the beauties of a heavy axe, and the wonderful advantage of a long handle. But it was all in vain; I was only wasting time; he could not understand it.

"Poor fellow," I thought, "he knows nothing of the beautiful science of physics. It is too bad that he should thus waste his strength through ignorance, and be unwilling to listen to the voice of wisdom."

We went to the wood-lot and began work. I had decided that we would work separately during the first day or two, in order that I might show him what I could do.

As I began to swing my axe, I felt proud of its ponderous blows that rang through the woods, and rather pitied the poor fellow who was drumming away with his little axe, taking about two blows to my one.

Presently I had to stop to rest, and then again, and still again. But Joe, my man, kept pecking away quietly, steadily, and easily.

Every few minutes I would stop to take breath; but Joe seemed perfectly able to do all necessary breathing without stopping his work for the purpose.

When night came, we piled up our wood and measured it. Joe's pile measured 1½ cords; mine only ¾ of a cord.

During the early part of the day, I had planned giving Joe another lesson in the evening, to see if I could not make him understand the elementary principles of wood-cutting, and the philosophical requirements of an axe.

But when night came I decided that perhaps it would be as well to let him go on in ignorance, and thereafter remained silent on the subject.

The next day I felt lame, and stayed at home. Joe put up his cord and a half as usual.

When I went to the woods again, Joe and I worked together. Not many days passed before I found an excuse for buying a lighter axe and a shorter handle. And every axe and handle that I have bought since then, has been lighter and shorter than its predecessor.

Whenever I use an axe now, I select one very much like Joe's, both in weight and length of handle. I can use this without getting at all out of breath, and can hit twice in the same place. The result is, I can do more and better work, and save a vast amount of strength.

I write this as a word of caution to the inexperienced wood-chopper, when about to purchase an axe.—H. L. C., in *Albany Cultivator*.

IMPROVED METHOD OF PRESERVING WOOD.—The improved French method of preserving wood by the application of lime is found to work well. The plan is to pile the planks in a tank, and to put over all a layer of quicklime, which is gradually slaked with water. Timber for mines requires about a week to be thoroughly impregnated, and other wood more or less time according to its thickness. The material acquires remarkable consistence and hardness, it is stated, on being subjected to this simple process, and the assertion is made that it will never rot. Beech-wood prepared in this way for hammers, and other tools for ironwork, is found to acquire the hardness of oak, without parting with any of its well-known elasticity or toughness, and it also lasts longer.

SABICU.—There has been a very active demand for Sabicu* during the past week to fill large Government contracts for the manufacture of saddle trees for the use of our troops in India. The Government authorities specified the use of an Indian timber called "Padouk," a wood of a reddish colour, and which is not attacked by the white ant, but from the absence of this wood in the English market Sabicu has been substituted.—*Timber Trades Journal*.

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* Sabicu is the wood of *Lysiloma Sabicu*, a leguminous species resembling acacia from Cuba, whence it is largely exported.

The wood is dark coloured, very heavy, hard, and durable, and owing to its hardness was used for the staircases of the Great Exhibition of 1851, when in spite of the immense number of people who used them, the stairs were found to be scarcely worn at all.—[ED.]

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MR. BRANDIS' WORK IN BENGAL.

MR. BRANDIS' first connection with the Bengal Forests occurred in 1869, with reference to some draft rules for the administration of Government forests in the Lower Provinces, which were drawn up by the Government of Bengal, and sent up for sanction to the Government of India.

The Government of India returned the rules with a memorandum by Mr. Brandis, pointing out their unsatisfactory character, and suggested that the question of new forest rules for Bengal should be deferred till the new Forest Bill had been passed by the Legislative Council.

Mr. Brandis objected to the distinction in the rules between reserved and open forests as not admissible under the Act, and also to there being no provision authorizing Forest officers to arrest persons infringing the rules, and because all power of confiscation was omitted.

This latter omission was due to a defect in the old Forest Act VII. of 1865, under which fines could only be imposed, where confiscation of implements was not provided for, and thus, as the Government of Bengal pointed out, the offender might escape with the trifling penalty of confiscation of an axe or a saw.

We have next a report by Mr. Brandis on the management of forests in the Jalpaiguri and Darjeeling Districts of Bengal, which he visited in January, February, May, November and December 1879.

The report commences with an account of fire protection in the Jalpaiguri sál forests, of which the Buxa and Apalchand reserves are the most important. The complete fire protection of those two forests is advocated by means of a series of fire lines, and two broad interior lines, 200 yards wide, burned through the midst of the forest. To those acquainted with the height of the grass in the Bengal sál forests, and the fierceness of the jungle fires, this great width advocated for fire lines will not appear at all excessive. Preliminary fire conservancy was advo-

cated for the other forest blocks, the grass in the open savannahs being burned early in the season, when that inside the forests is too damp to burn.

Mr. Brandis criticised the system of roads laid out at right angles to the drainage of the country, and advocated other roads between the watercourses and following the natural configuration of the ground, being in straight lengths wherever the nature of the ground would admit it. The forests being made accessible to carts by means of these roads, he hoped that a trade in dead timber would soon arise, as had already happened in the Oudh forests, the purchasers removing standing dead timber at fixed rates.

The attempts to grow teak in the Duars had been abandoned, the climate being considered unsuitable, though it seems to us on somewhat insufficient grounds. Some progress had been made in sál plantations, and Mr. Brandis advocated the use of strong transplants which had been bedded out in the nurseries several times, and were at least 2 feet high at the time of planting. The growth of grass tends to choke or draw up the plants into tall thin sticks, but if completely cleared they are apt to suffer from drought, hence the necessity for using large strong transplants.

Regarding the timber operations in the Daxa reserve, it had been prescribed in Dr. Schlich's working plan that 5,520 trees should be felled annually, but during the first four years only 2,800 had been felled, on the average, the reason being that owing to the abandonment of the proposed Rungpur-Dhubri Railway the demand for railway sleepers had greatly fallen off.

In spite of this, a large quantity of felled timber had been left growing in the forest, which was exposed to injury in case of fire occurring. Mr. Brandis, therefore, advocated more restricted fellings than those prescribed in the preliminary working plan, which as preliminary should be elastic. He also deprecated felling of fine trees within 50 feet of the roads, and within 100 feet of all open savannahs and of the boundary line, where a belt should be left to diminish the danger from fire, and to increase the chance of natural generation in the grass land outside the belts.

The sale depôts were at Alipur in the Duars, Kaunia, the terminus of a branch of the Northern Bengal Railway, on the Tísta river, and at Dacca.

At the latter place, sál from the Duars could not compete with the magnificent timber from Nepal, for which Rs. 4 per cubic foot was obtained, whilst only Re. 1-12 to Rs. 2 was offered for Duars timber.

There was also considerable difficulty in selling sissú wood, of which there is a fairly large supply, and Mr. Brandis advocated its being brought out in planks 3 to 6 inches thick,

and 10 feet long and as broad as possible, he also advised that considerable quantities of the inferior timbers should be experimented on as railway sleepers. Considering the large quantities of hard woods which the Assam forests supply, it would, however, be useless for the railways to attempt to use the softer inferior woods of the Northern Bengal forest, in which sál is the only timber fit for sleepers which is produced in any quantity.

The financial results of the working of the Jalpaiguri and Baxa Divisions for the preceding six years showed a deficit of nearly Rs. 40,000, but Mr. Brandis hoped that an equilibrium might be established by careful working for the future. If good Rangers were available in Bengal, it might be thought that the two divisions, which are both in one civil district, might be safely united into one.

The description of the standing crop in the Baxa Forest is very good—

"In certain portions of the Baxa reserve sál is found almost pure, or at least is the prevailing tree. In such localities, the forest is well stocked with a fine crop of well shaped poles, or immature trees from 90 to 110 feet high, and from 2 to 4 feet in girth, with occasionally an old tree among them.

"From what we know of the growth of sál, it may be inferred that these areas will be fit for cutting in say from 50 to 80 years. The large extent and good condition of the areas stocked with this class of forest constitute one of the most favorable features in the reserve; but there are other tracts of older forest, where sál is mixed with other kinds, and where it is by no means the prevailing tree. In the upper parts of the reserve (chelauni) *Schima Wallichii*, and *Lagerstrœmia parviflora*, *Dillenia pentagyna* and *Careya arborea* are common, but besides a few simal and chelauni trees to make dugouts, which are required by the parties removing dead logs, hardly any wood of other kind than sál is sold."

The next visit was to the Kurseong forests, where protection from fire of 10,170 acres of sál forest was being attempted, and detailed advice as to the measures to be adopted was given, at an estimated annual cost of Rs. 421 per 1,000 acres. In this division, 858 trees had been felled per annum since 1877-78, and the surplus for the last three years was nearly Rs. 60,000.

The third chapter of the report deals with the hill forests in British Sikkim, which form the Darjeeling Division. These forests are on three spurs radiating from a central point at Joro bungalow, at the foot of the Senchal mountain, and each spur forms a separate range, the total area of the reserved forests being 20,963 acres.

These forests are required for the fuel and timber supply of Darjeeling, but only an area of 9,384 is sufficiently accessible, and of this, we quote from the report:—

"A large portion lies at an elevation greater than 7,500 feet, where

in this district natural reproduction is exceedingly slow and uncertain, and where probably only very cautious selection fellings can be made, at any rate, for many years to come. Another portion lies at an elevation of from 7,000 to 7,500 feet, where reproduction, though better than at higher elevations, is not yet easy or certain, so that only a portion which may be estimated at between one-third and one-half of the whole area, remains at an elevation less than 7,000 feet, where, if the circumstances are otherwise favorable, reproduction may generally be counted upon.

"As a rule, it may be said that in India the greater the moisture, the more vigorous is the forest growth. But there are certain notable exceptions, and the higher hills of the Darjeeling District may be regarded as an instance in which excessive moisture causes the trees to grow slowly, and the natural reproduction to be uncertain.

"At lower elevations, where the temperature is higher, the process of transpiration through the leaves is more active; but above 7,500 feet it seems as if vegetation was almost stagnating during part of summer, while the air is saturated with moisture, and there is no sunlight to stimulate the action of the leaves."

At the time of Mr. Brandis' visit the steam tramway was being constructed, and by means of this and some new forest roads it was hoped to render an area of 12,257 acres available for the supply of Darjeeling, the annual requirements of which were—

	Maunds.
Firewood, ...	160,000
Charcoal, ...	10,000

or assuming that four maunds of firewood go to produce one maund of charcoal, the total amount of wood required is placed at 200,000 maunds. It was also estimated, that for the feed of the upper end of the tramway, 73,000 maunds would be required, but as the engines were then burning coal this item was omitted.

Mr. Brandis estimated that 100 maunds of wood corresponded to 175 solid cubic feet, so that the requirements of Darjeeling are—350,000 cubic feet, plus 150,000 of building timber, equal to 500,000 cubic feet per annum.

The yield per tree felled increased from—

45 maunds in		1877-78
to 111	do.	1878-79
and 285	do.	1879-80

this is partly due to the trees cut in former years being smaller, the practice at the time of Mr. Brandis' visit being to reckon nothing as a tree with a less girth than 3 feet, and a bole less than 20 feet, which was not the practice in 1877-78; but the chief cause of the increased outturn was that stumps of trees afterwards previously felled and of dry wood lying in the forests were utilized on a large scale, and that a considerable portion of the outturn was derived from this source, and not from trees felled.

Mr. Brandis advocated the strictest economy in utilizing stumps, roots and dry wood, and thus hoped that an outturn of 500,000 cubic feet of solid wood might be obtained by felling 2,500 trees annually, or at the rate of 200 cubic feet per tree. He admitted that the trees actually felled would not yield more than 100 to 150 cubic feet on an average, but hoped to obtain the balance by utilizing dry wood, and proposed to break up large stumps by means of powder or dynamite.

A calculation of the number of years during which the different blocks should be worked to give this yield of 2,500 trees per annum is sketched, and 74 years is the rotation selected for the whole area of 12,257 acres, the acreage worked over in any particular year varying according to the conditions of the growing stock, the nature of the soil, gradient, prospects of reproduction and other circumstances.

Thus the following summary gives the number of trees to be felled in each range:—

Name of Range.	Area in Acres.		Years.	Number of trees to be felled.	
	Above 7,500'.	Below 7,500'.		Total.	Per acre, below 7,500'.
Gumpahar, ...	412	3,400	25	62,500	18
Takdah, ...	697	4,336	38	95,000	22
Rangbul, ...	1,476	1,936	11	27,500	14
Total, ...	2,585	9,672	74	185,000	

Regarding the selection of the trees to be felled we quote as follows :—

"It is not intended to make complete clearances anywhere. Protection belts against wind must be left, and a proportion of young vigorous trees should remain in bands and groups, preference being given to the more valuable kinds for timber, and to those, such as maples, which are most likely to facilitate reproduction.

"A remarkable feature in these forests is the scanty natural reproduction, particularly at higher elevations, seedlings of oak are extremely rare, those of laurels found here and there, but not common, seedlings of maples, of the useless *Evodia fraxinifolia* are most frequent. Even where cattle are excluded, self-sown seedlings are scarce, except below 7,000 feet. Hence natural regeneration will not suffice to re-stock the forest, and planting must be resorted to."

Seed is however not readily obtainable, and "owing to the extreme damp, incessant rain and dense fog from May till September, and the extremely dry weather from February till April,

young woody plants develop with difficulty, and have to content with a luxuriant growth of herbs, brambles and other shrubs." Mr. Brandis advocates exclusion of cattle and fires, and sowing or planting in horizontal bands and lines, 20 to 30 feet apart, the plants being close together in the lines, so as to render supervision and clearing more efficient.

Mr. Brandis admits that by the system he proposed no material will be available except the forest above 7,500 feet, at the close of the 74 years, and that a yield of 40 cubic feet per acre per annum is very small, but he hoped then that more distant forests might eventually be rendered available by improved communications, and that it might be possible to lease a large adjoining private forest belonging to the Tchebu Lama, which was rapidly deteriorating through firing, grazing and charcoal making.

The fourth chapter of the report deals with the forests in the Tísta and great Rangít river valleys, forming the Tísta division, where most of the land had been given over to tea and cinchona and native cultivators, and where the reserved forest consisted of tracts below 3,000 feet elevation, in which sál is predominant, and of higher tracts above the range of sál.

Timber from these forests is required for export and for the requirements of tea estates.

Sál grows to perfection in the Tísta and great Rangít valleys, and an instance is given of a sál tree measuring 161 feet in total height, 86 feet of bole, and girth of 10 feet 8 inches at 4 feet from the ground.

The other valuable trees are—Tún, of which Mr. Brandis says that there are probably three species mostly between 3,000 and 6,000 feet elevation, and which is in great demand for tea boxes, gambhar (*Gmelina arborea*), sissú and *Ficus elastica*, but the trees had not recovered from excessive tapping in 1874. Other trees, such as simal and lampatia, the Assam kokan (*Duabunga grandiflora*) and *Canarium nepalense* were noted as probably useful for tea boxes.

One of the finest trees of these forests is mandania, *Acrocarpus fraxinifolius*, which attains large dimensions. The dimensions are given for two specimens as follows :—

	No. 1.	No. 2.
	feet.	feet.
Total height, ...	181	157
Height of bole, ...	110	100
Girth, ...	10	10

Regarding the forest growth of the high level forests, which is also common to those of the Darjeeling Division, we read that there are several species of magnolias—*Michelia excelsa*, common on the main ridge between 6,500 to 8,000 feet being the best; *Schima Wallichii* up to 5,000 feet is very common; Gobria (*Echinocarpus dasycarpus*), a large useful tree. The maples comprise *Acer oblongum* and *Thomsonii* between 2,000 and 5,000 feet; *Campbellii* and *Hookeri* forming the chief deciduous trees above 6,000 feet. Maple wood is largely used for tea boxes.

Other trees are *Bucklandea populnea*, *Terminalia tomentosa* and *myriocarpa*, *Morus lævigata*, giving a handsome yellow wood, and *Engelhardtia spicata*. Of the laurels, *Machilus odoratissima* and *Phœbe attenuata* from 5,000 to 8,000 feet. Oaks and chestnuts include *Castanopsis indica* and *tribuloides*, the former to 5,000 and the latter to 6,000 feet. *C. rufescens* and *Quercus lamelosa* and *annulata* from 6,000 to 8,000 feet, and *pachyphylla* 7,000 to 10,000 feet. The wood of *C. rufescens* and *Q. pachyphylla* is devoid of large medullary rays, and is not liable to split and warp like that of other large oaks. A birch, probably *Betula cylindrostachys*, is found up to 6,000 feet, sometimes gregariously, and *Prunus Puddum* and the walnut are not uncommon.

Mr. Brandis gives an interesting account of the jhumes of the Bhutirs, and of the terraced irrigated rice fields of the settlers from Nepal, and states that 6,000 feet is the limit of cultivation, and that forests above that elevation should be preserved; to the west of the Tísta river, for the supply of Darjeeling and of the tea estates, and to the east of the Tísta, for pasturage.

Grazing concessions were already allowed in the reserved forests east of the Tísta, and in order that these privileges might not eventually become rights, Mr. Brandis proposed that small grazing fees of 8 annas per head per annum should be levied, and that the blocks open to pasture should be defined, and should be protected against fire, and closed to grazing for a number of years if any fires should occur. We quote as follows:—

"Although, as above explained, it will not be possible to look upon these high level forests, thus proposed to be thrown open to pasture, as a permanent source for the supply of wood and timber, yet some precautions should be taken to prevent their deterioration through fires, lopping, and the cutting of saplings. With the exception of the northern slopes and of certain moister places, all these forests had been burned in 1879, and the destruction and damage done was enormous.

"It is to be expected that with the increase of population the herds of cattle sent to pasture in these hills will increase very considerably. The herdsmen will naturally desire to set fire to the forest for their own convenience.

"It should, therefore, I think, be provided that if any portion of these forests is burnt, the locality so burnt will at once be closed against cattle for a series of years, until the forest has recovered.

"The provision of the Indian Forest Act, section 78, which requires aid in extinguishing and preventing fires by all persons permitted to pasture cattle in the forests, will have to be strictly enforced in this district."

Although the first class forests were extended chiefly for timber, this need not exclude limited grazing, and the second class forests are chiefly to be used for pasture. The chief difficulty with the Tísta forests was financial, there having been a deficit of Rs. 30,000 in three years, but Mr. Brandis hoped that by care and economy an equilibrium between receipts and expenditure might be arrived at.

We quote a remark which is the foundation of the steady progress made in the surplus revenue of Indian forests :—

"Under existing circumstances in India the extent of forest divisions and the strength of the staff of Forest officers to be assigned to each must not be regulated mechanically by the number of acres to be managed, but must, to a much larger extent, depend upon the nature of the work, and the quantity of material required from the area. Forests which must be worked extensively obviously require a stronger staff than those where protection is the chief work to be accomplished."

THE PRIVILEGES IN THE BAHRAICH GOVERNMENT FORESTS.*

No rights in the Bahraich Government forests.—The whole of the State forests in Bahraich are reserves coming under

Note.—The great violence of forest fires in the Sikkim forests may be gathered from a description by Mr. Gamble, which we give:—

"On the 24th March, 1881, I was present at the burning of a tract of savannah forest belonging to the Chumta Tea Estate. The tract to be burned was cleared on all sides for a distance of 60 to 100 feet. The day was quite calm and rain had fallen two days before. But the mass of jungle was so dense that the flames swooped down on the grass on the opposite side of the cleared line, which was fully 60 feet wide. The heat was so great that it was hardly possible to stand at a distance of 20 yards on the opposite side of the fire line, and the leaves on the branches with which we provided ourselves were withered by the heat. Several flames burst out 20 to 30 yards ahead of the fire, from the scorching, radiating heat."—[Ed.]

* This memorandum is the substance of one that I submitted to the Deputy Commissioner of Bahraich at a time when there was a question of greatly extending the areas of forest closed to cattle in this district. Since writing it, 60 square miles have been added on to the 37 square miles that hitherto represented the area closed to cattle, and I am in hopes of again increasing this by 20 square miles. "Rubakárs," or charters, are also in process of consideration for each privileged village, and these will, it is hoped, when ready, lay down within precise limits the quantity of material which the former shall annually obtain and at the same time give protection to our administration and security to our control by making these grants subject to conditions of an unmistakable character on the part of the villagers. E. P. D.

section 3 of the Forest Act. They are not burdened with rights, but with certain privileges only that have been conceded on the understanding that they might be hereafter restricted at will according to circumstances, and according to the behaviour of those enjoying them in their relation to the conservancy of the forests.

Summary of privileges in the Bahraich forests.—If we except the privilege of pasture which is conceded to all alike, the populations living within three miles of the State forests are alone entitled to privileges within them, and this conditionally on their exercise being confined to the collection of what is necessary to them for household purposes. The privileges in the Bahraich forests can, therefore, be summarized as follows :—

1. The privilege of pasture, conceded to the general public.
2. The privilege to timber, and to firewood, and to various articles of minor produce, conceded to all cultivators living within three miles of the forests, and which can be classed into the following :—
   (*a*), timber for house-building ;
   (*b*), „ the construction of wells and bridges ;
   (*c*), „ the erection of platforms or "machâns ;"
   (*d*), „ the manufacture of implements and utensils ;
   (*e*), firewood;
   (*f*), thorns for fencing ; and
   (*g*), grass for thatching purposes.

The privilege of pasture.—The privilege of pasture is, as has been already mentioned, an unlimited one in respect of the number of persons who are entitled to benefit by it. There is no more serious question attaching to the Bahraich forests than this one of pasture. Upon payment of a rate, that is, in all cases, far too nominal in amount—2 to 8 annas per head per annum —to have any effect in keeping the cattle within bounds, every body can send into these forests as many cattle as he thinks fit. We can fancy the joy of an English farmer to whom should be given the opportunity, on payment of the above rate of from five pence to a shilling per head per annum, to graze as many head of cattle as he felt inclined to within a neighbouring and conveniently situated property of 30,000 acres, or more. Obviously this person would, if wise, dispose of his very boots to procure one more yearling. And in effect this is what is done in Bahraich. Not only do all the cultivators living off the forests trust more for a living to their cattle than they do to their crops, but a population has sprung up all around, and often within, our forests, of "Ahirs," "Goshis," "Banjaras" and other tribes of professional graziers, who either do not cultivate at all, or till a few patches only in the vicinity of their houses. People from afar again come and add to the dense packing of cows, buffaloes, sheep, and goats that, from year's

end to year's end, crowd through the Bahraich forests, trampling down the soil, wherever clayey by nature, to the consistence of a metalled road, by which means the stock is in many places drying up, and a condition of things being brought about that can only end in the ruin of the forest as a source of useful timber, and that at no distant period of time.

Condition of the Bahraich forests that are open to cattle grazing. Of the 325 square miles of the Bahraich forests, no less than 220 square miles must be classed as forest that nothing but the entire exclusion of cattle, followed in many instances by costly works of improvement, can save from utter destruction as such. Indeed of this extensive area at least 110 square miles is no longer forest except in name. It is past maintaining as forest, and is now, and can be hereafter, only useful in its capacity of affording pasture to cattle.

But the remaining half of this 220 square miles of deteriorated forest is still capable of great amendment under a proper form of treatment. For the most part, it comprises a collection of venerable and hollow old sál trees that stand in somewhat park-like isolation over bush and scrub, over stunted trees and crooked off-shoots, the produce of coppice and of pollard; the only variation being that sometimes the old trees are wanting, sometimes the undergrowth. Reproduction by seed over most of this immense area is either absolutely a failure, or is confined to species of a low order, or, if of sál, it, in most instances, comes to nothing. In the generality of cases the soil is of an adamantine hardness, being clayey by nature and much trodden down by cattle. Here nothing short of expensive artificial works will now conduce to the restoration of the forest to something of its original good condition. The exclusion of cattle alone will no longer avail; or rather we should have to wait a score of years or more for any serious improvement to show itself that had been brought about by these unaided means. However, this is no reason why we should not keep the cattle out if we can do so. On the contrary, seeing how long we have to wait, and how slow the process of improvement must be, we should lose no time in making a commencement, helping nature in the meanwhile by such artificial resources as we possess for creating that stock of valuable young trees that is now wanting.

In spite, however, of the cattle, we have in Bahraich good unclosed forest extending over an area of about 70 square miles. This exceptional circumstance is due to two causes. In the first place, the soil is here very light, and in the second place, the number of cattle is much less. But even here the forests suffer extremely from fires, that other evil and indirect consequence of grazing. Such young poles as we meet with, when not coppice standards, have been burnt down year after year for a score of years before they have been finally able to rise above this certainty of annual extinction.

Area of forest closed to cattle in Bahraich.—Of the 325 square miles that go to constitute the Bahraich forests, only about 35 square miles have been hitherto closed to cattle. This is a pitiful state of things. It is pitiful because we are thus ruining, in favour of a few thousands of individuals, forest which, of a right, belongs to a whole Province. It is pitiful because we are here, in all probability, only materially benefitting two or three great landlords whose wealth is already vast.

Bad policy of not commuting the privileges with which the Bahraich forests are burdened.—It is illogical to suppose that all these graziers are allowed to maintain themselves on the Rajah's land without being heavily taxed for the privileges enjoyed by them in our forests. The very cultivators of the soil are, for the most part, mere tenants-at-will of the talukdár, and it would be unreasonable to suppose that one and all of the privileges enjoyed by the former are not duly considered at the time of fixing the rent to be paid by them. If all the irregulated privileges bestowed by us upon the villagers had any effect in increasing their prosperity, there would be some reason for granting them. But in practice it is only the landlord whom we enrich. I have been told that we owe these privileges to the landlord, without which he would lose much of his income. This being the case, it would surely have been better to have assessed him at a sum which would have recouped him for the absence of these privileges, than to ruin, in his interest, property in which a whole province is concerned! These remarks, of course, apply to all the other privileges with which these forests are burdened.

Necessity for limiting the number of cattle that should be permitted to graze within the forests.—In any case I fail to see how the presence is to be excused of so many cattle belonging to persons who do not cultivate the soil, and of others who come from a distance. Again, there should surely be some limit to the number of cattle that even professed tillers of the soil, and privileged villagers to boot, should be allowed to graze within our forests. However, I am glad to understand that there is now some prospect of our being able to close a considerable additional area of our Bahraich forests; although the object kept in view apparently remains the same, namely, to always have a sufficient area of forest open for cattle grazing; *as if any area could be permanently sufficient for cattle that are not maintained themselves with any limit.*

I cannot do better than conclude what I have to say under this paragraph by inserting the following extract from a letter of the Secretary to Government, North-West Provinces, in the Revenue Branch, to the Secretary to the Board of Revenue, dated Allahabad, the 9th of January, 1885:—

"The Lieutenant Governor and Chief Commissioner agrees in the conclusions arrived at by the local officers that the villagers should

not have the right of *expending* their requirements unlimitedly. The forests cannot stand unrestricted grazing, and the general public, whose supplies of timber are daily becoming more scarce and dear, have claims on the Government which have to be considered as well as those of the villagers adjoining the forests."

Method of collecting the grazing dues.—I have fully entered into a discussion of the method pursued by us in collecting the grazing dues in a former correspondence with the Deputy Commissioner. This method leaves everything to be desired, and we cannot do better than adopt in its place the system just sanctioned by Government for the forests of the Dehra Dún. The main features of this system are :—

(*a*), a periodical cattle census ;

(*b*), the annual collection and payment into the treasury on the part of the village lambardár of the amount assessed to that village on the basis of the aforementioned cattle census ;

(*c*), outstandings to be realized by the tehsildár in the same way as ordinary land revenue ;

(*d*), lambardár to report and to realize the revenue upon any increase of cattle exceeding by 10 per cent. the number included in the last census ;

(*e*), lambardár to be paid for the additional duties thus imposed upon him by a commission of 5 per cent. on the amount of revenue annually realized by him from the cattle of his village.

But, before introducing this new system, I consider that we should, as a first measure, reduce the number of cattle within permanent limits, as already suggested by me, and moreover exclude cattle altogether from our forests—when the latter are not purely grazing reserves—that do not belong to *boná fide* cultivators living within three miles of them.

The privilege to timber and other forest produce.—Unlike what we have seen in the case of grazing, the privilege to timber and other forest produce is accorded only to the populations living within a zone of three miles off the Government forests, and those who are not cultivators by profession are not supposed to be included within the privileged classes. The privileged person receives all his domestic requirements in timber, firewood, thatching grass, fencing material, &c., &c., without payment of any kind. The privilege only extends to his personal wants, and it was not intended that he should be supplied with any more than is necessary to him for ordinary household purposes.

The application of this privilege is wanting in definition.—On the other hand, the application of this privilege has been very ill-defined. As matters stand, the privilege can be claimed, provided always the recipient live within three miles of the Government forests, by either the wealthy Rajah, the well-to-do Bunya, the servant, the labourer, or the agriculturist.

This was evidently not the intention of Government. The privilege should apparently only apply to those who are too poor to buy these things, to those who are engaged in the *bonâ fide* cultivation of that land which is assumed to be so preyed upon by the animals of the forest as to be, without this privilege, of very inferior value. The professional man, the merchant, the landlord, should therefore not be included within its scope, and it is necessary that the privilege be so defined in this respect as to render this perfectly intelligible to all.

The privilege is not sufficiently guarded against undue extension.—But although only accorded to the inhabitants of a well defined tract of country, and therefore in some sense limited, this privilege to timber and other forest produce is not protected in the way its importance demands from the possibility of its hereafter exceeding what the forests will be in a position to supply. We may find no difficulty just at present in providing the villagers with what they require, but we should certainly find it very hard indeed to give away in the same proportion to double the present population of the privileged zone. And there is nothing to show why this population should not increase fourfold. On the contrary, the privileges themselves are all encouragement to this increase.

Necessity for fixing in a permanent manner the annual demand of the privileged classes.—It is highly desirable therefore, that, as in the case of cattle previously discussed, so here, the forests should be taxed with a fixed annual demand only, and not with a demand capable of indefinite expansion, such as that with which the forests are now burdened. It is proposed at an early date to furnish each privileged village with a "rubakár," or charter, which shall indicate in an unmistakable manner the privileges to which the village in question shall be entitled. It is to be hoped that this principle of a fixed annual demand will form the basis upon which to build these village charters, without which the conservancy of the forests would be fettered to such an extent as to imperil their very existence.

Village "Rubakars" or Charters.—As in the case of cattle, so here, we have to determine the actual wants of each village in timber and in other forest produce; and the surest and most reasonable way, in my opinion, to obtain such very difficult data, would be to act as follows:—

(*a*). To come to an understanding in respect of the period of time after which supplies of timber should be renewed.

(*b*). To agree as to the proportions of the different kinds of timber which should be allowed in the construction of a villager's house, cattleyard, shed, "machán," &c., &c.

(*c*). To select off each forest a few standard villages, and to determine on the spot, by measurement, the quantity of timber and of other material made use of by them.

(*d*). From the above data to form an average of the annual

requirements of the standard village with a cultivated area of 100 acres: in other words, to reduce the average annual requirements of the standard village to the unit of cultivated ground possessed by it.

(*e*). To apply this average to all the other villages off the forest in question, according to the cultivated area of each.

Description of timber and of other forest produce to which the privileged villagers are entitled.—It has been seen that the privileged villager in Bahraich is entitled to all the timber that he may require for his own household purposes. On the other hand, he is limited both as to the dimensions of the trees that he can claim, and the species to which these trees may belong. He is not to be allowed anything larger than a pole, although, strange enough, no attempt has been made to define by actual measurement what is here meant by a pole. For certain purposes, however, such as for the construction of wells and the manufacture of sugar presses and other implements, the privileged villager is allowed trees of large dimensions.

Hitherto we have classed as poles in this district trees below 3½ feet in middle girth. The species to which the privileged villager is entitled include all with the exception of sál, shisham, tún, and huldú. As we have no tún, and but little shisham, he may be said to have a right to all species but sál and huldú. There is, however, an exception even here, because he is allowed dry sál trees of large dimensions for the construction of wells and bridges; and again, the "Tharoos," a peculiar tribe that has emigrated into the district from Nepal, is allowed dry sál poles (in season) for house-building purposes. I have placed 'in season' within brackets, because here again there has been no attempt to define precisely what quantity of this material should be ordinarily given to these people.

Number of privileged villages within the district, and value of the material annually supplied to them.—The number of villages that we have to supply as above is no less than 357, which is quite exclusive of the "purwas," or sub-villages and hamlets. The quantity of timber supplied during the year 1883-84 amounted to 400,000 cubic feet, and the value of the whole material to Rs. 48,000.

Capacity of the forests for yielding this annual supply.—We have seen that the area of forest capable of yielding anything at all in the shape of timber aggregates 225 square miles, of which only about 100 square miles can be pronounced sufficiently good forest to be able to supply the villagers with all these poles without injury to itself. I am afraid indeed that this good forest is nearer 80 square miles than the figure given above. It must be borne in mind here, however, that the excellence of the forest and its capacity for yield does not influence the demand upon it on the part of the privileged populations. The forests of Bahraich

are not compact. They are distributed in a long narrow line of a hundred miles or more along the Nepal frontier. They are not collected into one whole, but form six very isolated groups, all of which are more or less surrounded by a densely packed population. Unfortunately also, the poorest forests are those which are burdened with the heaviest demand, a demand of an annual and incessant character that has to be acceded to whether the forests are injured by it or not. The people must be supplied is the cry, *pereant silvæ, non populus.* The people in question being the inhabitants of a confined zone extending to a distance of three miles from the forests. It is perhaps surprising that these 357 villages, with their outlying hamlets and secondary villages, should consume so much every year. It must be borne in mind that each villager's house is burnt down on an average every four years, and that all the timber supplied to him can, therefore, only last that period. It is possible that if he had to pay for his timber the later would last him longer. Again, the quantity of material used by him for sheds, "machâns," and fencing purposes, is eaten up by white ants within the twelve months, and becomes hence an annual demand.

No proper restriction or control of the material removed by privileged villagers.—Again, no great attempt has been hitherto made to control the produce removed by the villagers. It is true that they can remove nothing without a permit, but then the difficulty is to know whether the person is a privileged villager or not. On the other hand, with the fear of well-founded discontent ever before us, and our desire to conciliate the people, we have given the privileged villager what he has asked us for, without any definite knowledge of the villager's requirements, and without any sanction for placing the demand of any one village on an immovable basis, we could not well do otherwise. It is quite possible that the privileged villager occasionally disposes of his material to outsiders. It is almost certain that non-privileged villages obtain supplies under cover of their alleged privileged character. It is hoped that many of these evils will disappear with the preparation of the village charters already referred to.

Damage done to the forests by the irregulated fellings of the privileged villagers.—The limitation in the dimensions of the trees to be given to privileged villagers was apparently made to suit as much the requirements of the latter as the taste for economy on the part of the giver. In the case of trees of a larger girth, the villager would be put to the expense of converting the log, as also to the greater cost of carrying it away. On the part of Government it was probably assumed that all these poles could have little or no intrinsic value, that their removal would even benefit the forest at large. Inferior species would, in this way, be weeded out, and the young trees of higher estimation be thinned where growing in too great numbers together. This

is certainly one side of the medal; but I shall now show that other side with which I, as an officer seeking to improve my forests and to protect them from injury, am necessarily most familiar with. In the first place, a very large area of our Bahraich forests, notably so the Bhinga and Sohelwa forests, is already so open and deteriorated, that hardly a pole of any kind can be removed from off it without detriment to the forest. Far from inviting thinnings and weedings, we here welcome the presence of thorns and brambles and other undergrowths, anything in fact which will hide the ground from the sun. And it is in such localities that I am obliged to let the privileged villager cut and fell! In the second place, the privileged villager does not thin. On the contrary, if he is fortunate enough to meet with a dozen suitable poles growing together, he will cut down the whole lot to the manifest injury of the forest. Again, we cannot expect of him to spare an entirely isolated tree. He never does spare one, not by any chance, unless it happens to be crooked. It may be said that we should watch over the villagers while in the forest, show them what to fell, mark the trees for them. As an alternative, it might be proposed that we should supply the poles ourselves. All this is quite impossible in practice. Where is the trained establishment to select and mark the tens of thousands of poles required by the villagers? If we did mark them they would not approve of them. Again, under existing arrangements, the villagers are allowed to come for timber and other produce at all seasons of the year, during all the days of the week. We are not allowed to interfere with them in any way whatever so long as they commit no offence that can come within the cognizance of the law. One of their most favourite indulgences is to fell their poles at a height of from 2 to 6 feet from the ground, by which means, of course, the possibility of a good coppice shoot taking the place of the original tree is considerably jeopardised. It is quite comprehensible that they should have strong objections to going any distance to procure their forest supplies, the effect of which is that the nearer the locality is to their homes the more injuriously is it felled over.

The damage committed by privileged villagers could be considerably lessened if they were confined to the less common and less gregarious species met with in our forests.—The damage done by these people would be considerably minimized if we did not permit them to fell in a forest those species which go to constitute the principal element in the stock. By such means as these we, to some extent, force the villagers to extend their operations. They can no longer conduct those unscientific thinnings which are just now playing havoc with certain parts of the Bahraich forests. They have to confine themselves to pure weeding. As an instance, many parts of the Bhinga forest are covered with a pure stock of ebony poles, while similar tracts

in the Sohelwa forest are stocked with a pure forest of dháo poles. It is there that the villager does most harm; it is here that he thins in village fashion, and denudes the ground.

Formerly the privileged villager was not allowed either ebony, dhao, or asna (*Terminalia tomentosa*). He did not then do so much damage. One of the inconveniences of having conceded to him these three species is that he now neglects to weed out any thing else, bringing all his energy to bear on these three, with the consequences already described.

The privileges require revision and modification before being finally laid down in the form of Rubakárs or charters.—It is evident to me that the nature of the privileges conceded by us to the villagers should be subject to important alterations, or at least modifications, before being authoritatively granted to them in a form which we could then no longer withdraw. I refer to the proposed village charters. They should only be allowed poles of such species which did not constitute a part of the dominant stock on the ground, so as to ensure their operations being entirely restricted to fellings that partake of the character of weeding.

The Forest officer should have more extended powers to deal with the privileged villagers.—The Forest officer should have full power to determine for each forest—

(*a*). The species to be felled by them.
(*b*). The localities in which they might alone fell.
(*c*). The fashion in which they should fell.
(*d*). The dimensions of the trees which they should alone fell.

In certain forests it might be necessary to forbid the cutting of poles altogether, and to give mature trees only.

The unfortunate consequence of these fellings being confined to poles is that all the fine straight-growing young trees are removed, while all the diseased and mis-shapen ones are left behind. Where is the future stock of mature trees to proceed from?

Obligations conferred on the villagers by the nature of the privileges accorded to them.—It may be well asked now what Government has demanded from this privileged population in return for the very valuable concessions made to it. It might have been anticipated that the villagers would not thus be allowed to help themselves, so-to-say, with timber and other produce, or even to graze their cattle within the State reserves, without undertaking in the most distinct manner, and under pain of well defined penalties, to submit to all those regulations that the Forest officer might consider essential to the proper management and working of his forests, and which did not interfere with the supply of their own requirements. But, strange to say, the villagers are not bound down to do anything of the kind.

No obligation to abide by the Forest officer's regulations.—The Forest officer is compelled to supply these people, but he has no legal claim for redress when the latter omit to abide by his

regulations, disobey his orders, cut where they ought not to, overfell in certain localities, and wastefully use the timber supplied to them.

Difficulty of keeping the cattle out of the closed tracts.—One of the greatest difficulties that we have to contend with is the exclusion of cattle from the closed portions of our reserves. And yet this should, in season, be no difficult matter at all; neither would it be so if Government had taken the precaution to insist that only cattle attended by herdsmen should be allowed into the State forests. It is past understanding that people should be allowed to act in our forests as they would, in this respect, not be allowed for a moment to act outside them. It is all very well to say that we have the power to pound these cattle, but the difficulty is to catch them, and when caught, to successfully conduct them all the way to the pound. This difficulty is so great that owners of cattle have been hitherto in no way intimidated by such pound fees as they have occasionally had to pay.

Throughout the great Bhinga forest the cattle find their own way to the forest and back again. Very many of them ultimately run wild. In this way there are large herds of ownerless cattle within our forests. We cannot catch these cattle without having recourse to expensive khedda operations, and we cannot shoot them without hurting the feelings of the people. The whole question shows how the herds of the villagers have been permitted—thanks to no restraint in the shape of a reasonable tax—to increase beyond the control, and beyond the requirements, of the villagers themselves, a fact patent to anybody who will go to the trouble of counting the numbers of maimed, diseased, superannuated, and otherwise useless animals, which are met with in every large herd of cattle, and for which we have, of course, to provide. No doubt one of the motives which urge the villagers to send their cattle into the forest unattended is to escape paying the dues—trifling as they are. There is then nobody on the spot of whom to enquire whether these cattle have been paid for; and then it is a cheerful thought to the privileged villager that, if his cows do wander into the rich pastures of the closed blocks, he is not there to encourage them. If he had been there, he might have been caught, while his cows are quite capable of taking care of themselves in this respect.

Obligation to assist the Forest officer in keeping out fires.—The only obligation under which the privileged villagers are is to assist in putting out fires when called upon to do so. They are bound to assist under pain of having their privileges withdrawn from them. It is only appropriate that this free assistance should be given towards the protection of that granary on which the villagers are dependent for their supplies; and if their services were willingly tendered in this respect we should not have

so much occasion to regret all that we have yielded to them. Unfortunately this is not the case. Of this condition of assistance imposed upon them by Government they are either ignorant, or else, from long immunity, they have come to consider it as having not been seriously intended. I do not think that this should be the position of affairs under an administration which taught the people, by its own attitude in regard to forest protection, how important it considered this part of our system to be. There can be no doubt that in Bahraich, as in so many of our forest districts, the people are incredulous as to their being any true sympathy on the part of the Magistrate for the objects aimed at by the Forest officer. And so long as the people believe in this supposed antagonism, so long will they grudge their assistance to the Forest officer. Forest conservancy is, of course, not a popular branch of our administration, and we can hardly hope to see the people with us when they, in heart, believe their lord and master to be imbued with the same spirit of distrust in regard to our proceedings. This state of things probably accompanies the first stages of forest protection in every part of the world, because there is much in the system which must, at first sight, appear somewhat harsh and uncompromising to those who have not had the time to study it more intimately. All that we can demand, under these circumstances, is that the unprofessional man in authority should give the Forest officer the credit of knowing his own work best, and that, when in a position to further the legitimate aims of the latter, he should not allow his undoubted duty to be warped and narrowed in effect by his possession of views on the subject which he knows are not the views of the Government which employs him.

E. P. DANSEY.

NOTES ON SOME PLANTS AND BIRDS FOUND IN THE HILL FORESTS OF SOUTH-EAST KUMAUN.

THESE forests, situated close to the Nepalese frontier, and forming the limit of the North-West Himalayas to the eastwards, are of special botanical interest.

They consist chiefly of sál and sain with a variable proportion of other trees, such as dhaura (*Anogeissus latifolia*), sandhan (*Ougeinia dalbergioides*), kat bhilawa (*Buchanania latifolia*), bhilawa (*Semecarpus Anacardium*), gosam (*Schleichera trijuga*), rauni (*Mallotus phillipinensis*), dhaula (*Phyllanthus Emblica*), *Phyllanthus nepalensis*, several *Grewias* and *Bauhinias*, whilst huldú (*Adina cordifolia*) is plentiful at the foot of the hills and finds a ready market. Shisham (*Dalbergia Sissoo*) occupies the silt deposits in the river beds together with khair (*Acacia Catechu*), which also occurs here and there on the hill-sides, whilst chir (*Pinus longifolia*) covers the higher ridges.

Sál, however, almost always predominates, but appears to

grow more slowly than in the forests outside the hills. The trees have not the same vigorous appearance, and are, as a rule, crooked and somewhat stunted, the average height being about 70 feet; many are also unsound. Mr. Brandis in his suggestions of 1881 remarks that "the slopes with a northerly aspect are mostly moist and shady, so much so as to affect injuriously the growth of young sál. In a plot numbered 47, and extending from the Nindhaur river nearly half way up the ridge, which I examined on the 7th March, I found a large number of seedlings of sál, with last rains' leaves and the whole shoot above ground killed, not by frost or other injury, but apparently by an excess of moisture. It is probable that these plants will shoot up again, and that eventually they will grow into seedlings; but the general appearance of young sál on that slope showed that the conditions for the natural reproduction of that tree were less favorable than on the warmer and drier slopes with a southerly aspect." This certainly seems to be the case in the Upper Kalaunia forests, at an elevation of from 1500 to 3000 feet, where the reproduction of sál is, as a rule, very good on southern slopes, whilst frequently insufficient on the northern ones.

The following tables give the number of trees of different diameter classes of sál, sain, shisham, khair, and chir per acre in two blocks, Sarra South and Sarra North, occupying the upper basin of the Kalaunia. The former block with an area of 3,000 acres has generally a northern, the latter with an area of 4,500 acres generally a southern, aspect.

The tables show that the northern aspect is not always the most favorable, and that other factors beside aspect, such as excess of moisture, soil, and the configuration of the ground, here play an important part. It must also be mentioned that the comparison is more unfavorable to the northern slope than appears at first sight, owing to the fact that the proportion of chir is greater, and the elevation of certain points somewhat higher than in the other block.

Sarra South.

Name.	Diameter.				Total.
	6—12 inches.	12—18 inches.	18—24 inches.	over 24 inches.	
Sál, ...	6·7	4·8	2·2	1·3	14·5
Sain, ...	2·1	1·5	·8	·5	4·9
Sissú, ...	·2	·1	...	...	·3
Khair, ...	1·7	·1	...	...	1·8
Chir, ...	1·4	1·6	1 2	·6	4·8
Total, ...	12·1	7 6	4·2	2·4	26·3

Sarra North.

Name.	Diameter. 6—12 inches.	12—18 inches.	18—24 inches.	over 24 inches.	Total.
Sál, ...	23·3	9·5	3·3	1·5	37·6
Sain, ...	1·7	1	·6	·6	3·9
Sissú, ...	...	...	...	...	·1
Khair, ...	...	...	...	...	1
Chir, ...	·4	·3	·1	...	·8
Total, ...	25·4	10·8	4·0	2·1	43·4

From the above it will be seen that in Sarra North there are more than thrice as many sál per acre of 6 to 12 inches in diameter, and more than twice as many sál of 12 to 18 inches in diameter as there are per acre in Sarra South, whilst in the last diameter class, including trees over 24 inches, the proportion is almost the same. The sain has not varied so much, but there is on the whole one tree per acre more in Sarra South than in Sarra North. The grand total shows that as regards the species counted Sarra North is nearly twice as well stocked as Sarra South, and if all the other trees had been included this result would not probably have been seriously impaired.

The bamboos in both the blocks are very fine and abundant in places. There is a large export. The wild date palm (*Phœnix sylvestris*) is a marked feature of the undergrowth. The inner portion of the short stem is eaten by the Kumaunis, and porcupines seem very fond of it. *Indigofera* was also common, and *Reinwardtia trigyna* conspicuous by its yellow flowers.

The great moisture in Sarra South is indicated by the greater abundance of epiphytical orchids and of climbing arums than in the forests to the west, whilst in some of the very shady damp ravines a curious fleshy *Asclepiadaceous* plant, with slender follicles over a foot long, perhaps *Hoya arnottiana*, was not rare. Besides the associates of sál mentioned above, harra (*Terminalia Chebula*) is frequent, but only as a small low tree, very different from the fine trees of the same species in Burmah and on the Satpuras.

Hymenodictyon excelsum was conspicuous by its white bracts fluttering in the gentlest breeze, *Antidesma diandrum* by its red, and *Osyris arborea* by its orange, berries.

Only two trees of *Bischoffia javanica* were observed, both laden with fruit, which seemed a favorite with the green pigeons.

Alstonia scholaris with its leaves in whorls of 5 to 7 was rare, *Marsdenia tenacissima* not uncommon. The *Myrsineæ* were well

represented by *Mæsa argentea, Myrsine semiserrata* and *Embelia robusta.*

The jaman (*Eugenia Jambolana*) was common along the banks of shady streams, and another *Eugenia* species unknown, with handsome broad shining coriaceous leaves, was found in the Dula Gad.

Acacia lenticularis was fairly plentiful in some localities. Its legumes resemble those of an *Albizzia.*

A grove of *Citrus medica* surrounding a marsh, the shrubs being laden with large limes, was discovered at Durga Pipal, and seemed undoubtedly wild.

Small trees of *Saraujа nepalensis* were not uncommon with panicles of pink flowers (in February). For an account of the various seasons given for the flowering of this tree, *vide* Mr. Duthie's article on North-East Kumaun in the *Indian Forester* for January last.

But the botany of South-East Kumaun is of especial interest, owing to the number of plants which here find their westward limit, such as :—

Heynea trijuga.
Piptadenia oudhensis.
Heptapleurum venulosum.
Hyptianthera stricta.
Mæsa argentea.
Bassia butyracea.
Symplocos racemosa.
Schrebera swietenioides.
Thunbergia coccinea.
Ficus pubigera.

Heynea trijuga was conspicuous in February by its round red capsules resembling small cherries. Only small specimens were observed of 2 to 3 feet in girth. Neither Hooker nor Brandis mention this as being found in Kumaun, but both state that it occurs from Nipal eastwards.

Heptapleurum venulosum was very abundant and showy with its flowers in large paniculate umbels.

Hyptianthera stricta, said by Hooker and Brandis to occur from Oudh eastwards, was here found abundantly as a shrub by the side of small shady streams associated with *Mæsa argentea,* the latter being easily recognised by its small white berries.

Bassia butyracea was tolerably abundant, and its white succulent flowers possessing something of the taste and smell of the mohwa (*Bassia latifolia*) seemed to be much appreciated by both birds and insects. Mr. Brandis in his Flora states that a soft solid vegetable butter is extracted from its seeds which does not melt in the plains. Ghee is adulterated with it in Kumaun, but as the tree was only in flower none of the seeds could be procured.

Symplocos racemosa was pretty common. It is stated by

Hooker to occur throughout North-Eastern India from Kumaun to Pegu.

Schrebera swietenioides, which is only known in the Sub-Himalayan tract from this locality, was met with on two occasions on southerly slopes. Its wood is said to have some of the properties of boxwood.

Thunbergia coccinea, a large climber, frequent, according to Hooker, from Kumaun to Bhotan, was conspicuous in damp places by its lax pendent racemes of red flowers.

Ficus pubigera, was not uncommon. It extends eastwards to the Khasia hills.

Many of the birds are very beautiful, and a slight acquaintance with them would do much to lessen the monotony of a forester's existence.

Along the streams live several kingfishers, the commonest perhaps being the white-breasted kingfisher, whilst in well-shaded secluded nooks, where the water is stagnant or runs slowly, sits the lovely brown-headed kingfisher with his bill blood-red, his body buff-colored, his back a bright azure blue, and his wings bluish-green, but the king of them all is the large crested black and white kingfisher watching for his prey from a fixed perch, not hovering over the water hawk-fashion, like his small relation in the plains.

On a rock, in the midst of a roaring torrent, feeding on the larvæ of water-insects, may often be seen the yellow-billed whistling thrush, which at a distance resembles an ordinary blackbird, but on a closer examination is found to have each feather streaked with shining cobalt blue. On being disturbed he flies off with a loud musical whistle.

By waterfalls, climbing up the wet and slippery rocks with wonderful agility and busily feeding on the various aquatic insects and larvæ found at the edge of the water left behind by a wave, may be spied the plain little plumbeous water-robin, or perhaps that prettiest of all the wagtails, the spotted fork-tail, engaged on the same business. The handsome white-capped redstart so called, although only the male possesses the white cap, picks up a living in like manner, but prefers the quieter parts of the streams to the rapids.

Along the more level and shingly portions of the rivers the pretty and delicate grey and yellow wagtail and the common sandpiper, may be seen, whilst amongst the plovers that well-known and wily bird the red-wattled lapwing, which seems to perform the duties of sentinel for all the rest of the animal kingdom, with its oft-heard warning cry on the approach of danger of "Pity to do it," "Pity to do it," is everywhere. After some heavy rain two other plovers were also observed feeding in the freshly deposited mud, *viz.*, the spur-winged lapwing constantly jerking its head in the oddest manner as if it wished to fight, and the stone plover, which is also found in England.

Some sportsmen call the latter the goggle-eyed plover on account of its large yellow owl-like eyes, or sometimes the jungle-hare, from its habit of flying a little distance and then running and hiding itself squatting very close. Outside the forest in the Kumaun Terai, in open uncultivated land, the Indian courier plover was almost everywhere running about, rapidly nodding its head as if it had a stiff-neck which it wanted to set right.

Flitting about hunting for spiders and beetles on rocks and perpendicular cliffs along the rivers, with the fine red patch on its wings displayed to full advantage, may be seen one of the tenuirostres, the red-winged wall-creeper.

The birds which thrust themselves most on one's attention in the forest are undoubtedly those noisiest of all imaginable birds the babblers. The worst of them all is the white-crested laughing thrush, which goes about in large flocks of 20 or more, every now and then bursting into a chorus of most discordant laughter quite startling at first, not perhaps quite so objectionable is the white-throated laughing thrush, and then in the third place comes the well-known Bengal babbler, commonly called the sat-bhai.

One cannot also fail to be attracted by the constant tapping going on all around the camp by the woodpeckers *et hoc genus omne*.

The following were common :—

The Himalayan tree-creeper.
The Indian spotted woodpecker.
The golden-backed ,,
The scaly-bellied green ,,
The Bengal rufous ,,

The latter is supposed not to be found west of Kumaun.

The noisy and gregarious slaty-headed parrakeets were plentiful, the great and the common grey hornbills were met occasionally. Of the former Jerdon says that the noise of its wings can be heard from a mile distant. It breeds in holes in large trees, and the male is said to build the female in by covering the hole in the tree, where she incubates, with mud, leaving only room for her bill to protrude and receive food from his.

Bulbuls were plentiful, the commonest being the white-cheeked crested bulbul and the common Bengal bulbul, whilst the black-crested yellow bulbul occurred in places only, and the Himalayan black bulbul was only seen feeding on the flowers of *Bassia butyracea* in company with the black-headed sibia.

Amongst pigeons and doves the spotted and the common ring doves were innumerable near cultivation, but the beautiful bronze-winged dove was only observed in one locality. Blue rock pigeons had taken possession of some of the cliffs, and the green pigeons were enjoying themselves feeding on wild figs and other fruit.

Amongst game birds the jungle fowl, the kalij, the black

partridge and the bush quail were plentiful, the peacock less so.

The common Indian magpie was everywhere, and seemed as wary as its European cousin, but the handsome red-billed blue magpie, with a tail 18 inches long, was only observed in one spot.

The brilliant little scarlet short-billed minivet, with his yellow robed wife, was not common, neither was the Himalayan red honey-sucker, a glorious little creature like a humming bird, with its head a dark shiny metallic green glossed with purple, its back dark-red, and its rump bright yellow.

A single specimen of that curious bird the large green-billed malkoha was obtained. Its bill is a bright apple-green, a rare color for a bird's bill. A Maronne oriole was also shot. It does not at all resemble the common Indian oriole, its head and wings being black the rest glistening maroon-red. It is said to be found only in the Eastern Himalayas extending east to Tennasserim.

The rufous-backed shrike was to be seen everywhere. Its character is very well drawn by Eha in "Tribes on my Frontier." The large cuckoo shrike was much rarer, and the ashy swallow shrike was only found in one place, but there it occurred in large flocks.

The restless little white-throated fantail was often noticed hopping about large trees catching small flies in the air, and constantly spreading and raising its large fan-shaped tail.

When a forest fire occurs, the Jay-like Indian rollers will be observed making their way towards the scene of the conflagration from all sides, and taking up their posts on advantageous trees, from which they sally forth to catch the numerous insects, &c., which are trying to escape; then appear the king-crows hovering about in the air devouring choice morsels, and lastly following in the wake of the flames come those neat respectable birds, as Eha calls them, the mynas, who pick up all the cooked larvæ, &c., they find on the ground.

Sambhar with magnificent horns abound in parts, but we have no time to discuss the pleasures of the chase. With such a flora and fauna, including a fair amount of game, no forester should be able to say with his brother officer the policeman, that "his life is not a happy one."

JARUL TIMBER

JARUL TIMBER.

The June Number of the *Indian Forester* contains a report on experiments made on the Northern Bengal State Railway with sleepers made from certain Assam timbers,—among them Járul, *Lagerstrœmia Flos-Reginæ*,—from which it appears that, after 5 years use in an unballasted siding, where of course white ants and damp would get fair play, out of 100 Járul sleepers

48 were found to be in good and 11 in fair condition. And in the first article in the same number of the *Indian Forester* it is noted that attempts are being made to grow Járul in Assam. Having had some experience at Akyab of the timber called *Járul* by the Bengalees there, and *Pyémma* (not, I think, *Pymma* as Gamble has it) by the Burmese, I am puzzled how to reconcile that with the account given by Gamble of its qualities, and with what is now reported of the experimental *Járul* sleepers.

When I took over charge of the Arakan (P. W. D.) Division in 1867, a large jetty was being finished, of which the piles were all either ironwood, *Xylia dolabriformis*, *Pynkado*, Burmese, or so-called *Járul*. The piles were whole trees, unsquared, and the largest were over 50 feet in length and up to nearly 3 feet in diameter at the butt. The Járul piles were all brought from up the Koladyne River, and they were I think of two kinds, known as red and white *Járul*.

The white Járul was I believe the same wood that was used extensively in Akyab for beams and planks in house-building, as being much cheaper than ironwood or teak, but it was notoriously a favorite food of white ants. It had a grain like ash, and was of about the same color. Gamble says that Járul (*L. Reginæ*) is the most valuable timber of Sylhet, Cachar and Chittagong, and in Burma the most valuable after teak, but he describes the wood as being light red. Not having had any thing to do with the procuring of the piles for the jetty, I cannot say positively that either the white or the red wood, called *Járul* at Akyab, was the produce of *Lagerstrœmia Flos-Reginæ*, but I think there were specimens of that tree at Akyab, and that I was told it was *Járul*. And I have seen the *Lagerstrœmia* in Pegu, and heard it called *Járul* and *Pyémma*. At this distance of time, having left Burma in 1870, I cannot recollect having seen the red *Járul* in general use, except for the paddles of canoes, for which it was admirably adapted. The color and grain were like a darkish mahogany.

While at Akyab I had to substitute ironwood for white *Járul* beams in the roof and floor of the Treasury. The earth oil with which the beams had originally been smeared had lost its virtue, and the white ants had got in. After an interval of leave and other duty I again received charge of the Arakan Division towards the end of 1869, and was surprised to find the T head of the jetty in already extensively in need of repair. The *Járul* piles, braces and walings were rotting, and the pile heads were being eaten up by white ants, though they stood fully 500 feet from the shore at high water! The decay extended to low water mark, but below that the Járul timber seemed to be quite sound. The destruction by white ants stopped at high water mark. It had before become known during the construction of the jetty that whereas the *Teredo navalis* freely fed on, or bored through,

ironwood, it rejected *Járul* as being unpalatable or unwholesome, and then, if I recollect rightly, the natives said they knew that *Járul* did not stand exposure to the weather, or being alternately wet and dry, as were the piles and timbers down to low water mark. The timber of the jetty of both sorts had been carefully sheathed with tarred felt and Muntz metal, as protection from the *Teredo*, but in the case of the *Járul* this proved the means by which the white ants were enabled to effect the destruction of the pile-heads. At that distance from the shore it was of course a puzzle, first, whence came the white ants, and, second, whence they got the earth with which they make the galleries without which they cannot, or do not, like to work. There is no doubt that the white ants came from Calcutta or Chittagong, and were landed from the mail steamers, for the use of which chiefly the jetty was built. The cargo was stored in a closed shed on the T head of the jetty until sent for by the consignees. Even ships themselves are sometimes damaged by white ants. In 1865, I think, the Lighthouse schooner "Alguada" was found to be nearly eaten up by them, but where the earthy medium came from in that case I did not hear. Perhaps those interesting little creatures were then made innocent scapegoats, as in the celebrated case in which rupees were said to have been eaten by them. But in the case of the Járul piles there was no mistake, and I got literally to the bottom of it. When making a survey of the damage done I stripped off the felt and metal sheathing, and found that the ants had worked their way down inside or through the felt to considerably below high water mark. This of course they did while the tide was low, and there they found the earth they were in quest of, in the shape of silt, deposited from the muddy water of the Koladyne estuary! I saw them going down and up, and they were not there eating the timber. The galleries the ants had made through and through the pile heads above high water mark were as usual lined or filled with earth. I estimated for cutting off all the Járul piles down to low-water mark; and putting ironwood heads (ironwood, or *pynkado*, withstands white ants and weather) on them, but the Arakan Division was abolished, and I was transferred to Bengal before this was sanctioned, and do not know what ultimately was done. I believe, however, that the timber jetty continued to go to grief, and that it has been replaced or superseded by an iron one. I cannot recollect whether I found any *red Járul* on the pier-head thus rotten or ant-eaten, but I am under the belief that both red and white timber was used in the work.

What then was this white Járul, that withstood the teredo but was so easy a victim to the termite, and that was durable (for some years at least) under salt water, but unable to resist the weather? Was it a *Lagerstrœmia* at all? Gamble does not say whether the *Lagerstrœmia Reginæ*, which has a red wood,

resists white ants. I hope that some fellow subscriber, if not the Editor, will be able to clear up this point for me, and to give some further particulars as to the merits and demerits of the red and white *Járuls*.

C. W. HOPE.

MUSSOORIE,
18th June, 1885.

DIMENSIONS OF A TEAK TREE.

Dimensions of a teak tree sown at the Kulsi plantation, Kamrúp, Assam, in 1874. Cut down in 1885. Age 11 years, annual rings 11.

No. of section.	Length.	Girths. 1	Girths. 2	Girths. Mean.	¼ mean girth.	Cubic contents. ′	″	‴	Remarks.
	ft.	ft. in.	ft. in.	ft. in.	in.	′	″	‴	
1	14	2 -9	2 -3¼	2 -6	7½	5	5	7	By Hoppus' measurer.
2	12	2 -3¼	1-10¼	2 -1	6¼	3	3	..	Total height, 67 feet.
3	12	1-10¼	1 -5¼	1 -7¾	4¾	1	10	6	The first girth was taken at butt, and the last at 50 feet.
4	12	1 -5¾	1 -1¾	1 -2⅛	3½	1	..	3	
Totals,	50	..	..	..	..	11	7	4	

The tree has thus grown at the rate of 1 cubic foot per annum, and the heartwood at the butt covers five annual zones.

A. J. Mein.

THE BAGNERIS MEMORIAL.

The object of the Bagneris Memorial Fund having been now finally settled, some account of what has been done will interest the readers of the *Indian Forester*.

The scheme has not been so well supported as might have been expected, but 31 officers have subscribed Rs. 1,170, which

has enabled us to carry out our plans more fully, than was at one time expected.

Various suggestions were made and discussed with regard to the form of the memorial, and it was at first intended to place a bust of M. Bagneris in the Nancy Museum, but this idea was eventually abandoned.

First, because M. Puton, the Director of the School, thought the scheme too ambitious, and *secondly*, as the funds subscribed were not sufficient to enable this to be done, the cost of a bust being estimated at not less than Rs. 1,500.

After some delay it was finally decided that the memorial should take the form of a marble medallion, and Colonel Pearson and M. Boppe kindly undertook to negotiate with a rising young artist of Nancy, named M. Benoit Godet, who, every one admits, has done full justice to the work entrusted to him.

The medallion is of white marble in relief, surrounded by a massive carved teak frame, the wood for which was forwarded from Burma by Mr. Aplin; the size of the medallion and its frame is about 4′ × 4′, and all who have seen the original pronounce it to be a real work of art. A large photograph of the medallion was sent to me by Colonel Pearson, and from it I had reduced copies taken, which have been sent to the subscribers in order that they may judge for themselves of the merits of the work.

The completion of the medallion and the construction of the frame naturally took some time, and it was not till March 1885, that it was finally completed, and made over to the Director of the Forest School by Major Bailey, who kindly undertook all arrangements after the departure of Colonel Pearson from Nancy.

There having been a small balance over after paying the artist and defraying all other charges, in connection with the memorial proper, it was decided to place an album of Indian workmanship in the Nancy library, which will, eventually I hope, contain the photographs of all Indian Forest officers who were pupils of M. Bagneris, or who have received instruction at Nancy.

A very handsome inlaid sandal-wood album case has therefore been purchased for Rs. 45, and was forwarded to Major Bailey, who has arranged to have it fitted up and provided with an outer teak case, and he has now placed it in the library of the Nancy Forest School.

Eighteen photographs of former students have been received and forwarded to Major Bailey, and it is hoped that those who have not yet sent theirs will kindly do so either to me, or to Major Bailey at Nancy, as soon as possible.

I almost omitted to mention that the artist who executed the work, kindly offered a number of reduced clay moulds of the

medallion to Major Bailey, who has disposed of them in the following manner :—

1 to M. Bagneris' family at Nancy,
1 to the India Office,
1 to Colonel Pearson,
1 to the Inspector General of Forests in India,
1 to the Dehra Dún Forest School,
1 to myself,

The models for distribution in this country have been sent free of charge through the India Office, but have not yet come to hand.

I have received the following letter from M. Puton, Director of the Forest School, in recognition of the presentation of the Bagneris medallion to the Ecole Forestière at Nancy :—

Nanci, le 10 Mars, 1885.

Mon cher Camarade,

Je viens vous exprimer toute ma reconnaissance du touchant souvenir que les anciens éléves anglais ont, sous vos inspirations, envoyé à l'Ecole.

J'ai fait installer le médaillon du professeur Bagneris, avec son bel entourage en bois de teck, dans la plus grande salle des collections, et à la plus belle place. Soyez bien persuadé que, cette place est fort minime á coté de celle que tous les professeurs, les éléves français et moi, nous vous gardons dans nos cœurs et nos affections.

Tous ici me chargent de vous exprimer leurs sentiments de gratitude et d'amitié. Je le fais, croyez le bien, avec un réel plaisir, et je vous prie de vouloir bien transmettre aux anciens éléves anglais, nos dévoués camarades, avec mes sentiments personels, l'expression de cette unanime reconnaissance et de cette durable affection.

Veuillez agréer,
Mon cher Camarade,
Mes sentiments les plus dévoués,
L'Inspecteur Général des Forêts, Directeur de
l'Ecole Forestière, Compagnon de l'ordre Impérial de l'Inde,

PUTON.

In conclusion, I must not forget to mention that, some time ago I received through Colonel Pearson, from M. Bagneris' family, an expression of sincere thanks to all subscribers, for the unexpected honor which has been bestowed on the memory of their late lamented father.

E. McA. MOIR.

GAMBOGE.

CAN you or any of your readers give me any information concerning the processes for extracting and preparing gamboge?

Near Belin, a small town in Burma, the *Garcinia succifolia*, called in vernacular 'Thanataw,' grows very sparsely, but there is another gum, *Garcinia Cambogia*, called in the vernacular 'Thaungthalé,' which grows rather more extensively near the small town of Sittang.

The inhabitants of these places are perfectly ignorant of the use of the tree, neither do they, after being informed of what value the tree is, understand the processes of working, and unfortunately I am unable to give them any information on the subject.

Of these gums the *Garcinia succifolia* appears to produce the best gamboge, and although the tree is so scarce that the inhabitants state that there is one tree in a certain place, and two trees in another place, they probably would find more if it was made worth their while to look for them, and if they were shown some easy process for the extraction of gamboge.

Seeing is believing with the Burman; he seldom speaks the truth, and does not give any one the credit for doing so, and unless the processes for working are very easy, and are personally shown to him, he will not believe in them, and will not take the trouble to work.

H. B. WARD.*

'AMARI' WOOD.

At the request of Mr. W. H. Bennett I write to inform you that from enquiries made about the "Amari" wood,† a sample of which Mr. Bennett had consigned to him in London, I find that it is a very hard wood, and the wood merchants think too hard to work, but as to the probable value they will not give an opinion, as it appears none of them import direct, but buy from sales at the docks, and they say the best plan will be to send a small quantity to some broker in London and have it sold by public auction, when if sold and found a suitable wood for manufacturing purposes, you would probably have enquiries for more of it.

S. W. MILLAR.

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* We would refer our correspondent to Mr. Mack's paper on Gamboge on page 892 of this Number.—[ED.]

† *Amoora spectabilis* of Assam.

III. Official Paper.

GAMBOGE OF BURMA.

Although various varieties of gamboge-bearing trees have for many years past been known to exist in different parts of the province, notably in the Tenasserim division, it was not until comparatively recently that the subject was brought specially under the notice of the local Government. Writing more than 30 years ago, Mr. Simmonds, in his work entitled *Commercial Products of the Vegetable Kingdom*, says: "The *Garcinia elliptica* of Tavoy and Moulmein affords gamboge and approaches very closely in its character to Graham's *Hebrodendron*;" and he adds that it affords "a fine pigment." Dr. Mason also, in his work on Burma, remarks that "the best gamboge is produced by *Garcinia elliptica*, but an inferior article is produced by *G. cornea*, *G. anomala*, *G. cowa*, *G. kydia*, *G. succifolia*, *G. xanthochymus*, and *G.* (*Hebrodendron*) *morella*. *Garcinia Cambogia* yields a pleasant fruit and a gamboge quite insoluble in water, and it is the complete solubility of the best gamboge that distinguishes it from inferior sorts, but it is probable that, when fully investigated, these insoluble gamboges will be found of service in the arts."

In 1875 Mr. Whittall, of the Forest Department, drew attention to three different species of trees, belonging to the genus *Garcinia*, growing in the districts of Southern Tenasserim. These were known to the Natives as *Tawmengoot*, *Parawah*, and *Parajay*. The two last named Mr. Whittall did not consider of much account. The *Parawah* yields an exudation of a white colour, which changes to a reddish yellow on exposure to the atmosphere, and is scarcely at all soluble in water, but yields to alcohol. The *Parajay* yields a rather copious exudation which, when dissolved in spirits of turpentine, affords a beautiful, permanent, yellow varnish for metallic surfaces, and on this account has been called the gamboge tree as well as the yellow varnish tree; but its exudation does not form an emulsion with water, and, for this and other reasons, Mr. Whittall considered it had no claim to be considered a real gamboge tree. The *Tawmengoot* was, in Mr. Whittall's opinion, the gamboge tree of the South Tenasserim forests. He says: "The gum resin is larger in quantity and darker and of a more glossy colour than the others: neither wet nor dry is it so sticky, and so readily does it form an emulsion with water that the exudation on the

outer bark is completely washed away by the rains." This tree he believed to be the same as that which Dr. Mason calls *Thanataw (Garcinia elliptica)* [*G. heterandra*], and he adds that it was supposed to be the same as that which yields the gum resin exported from Siam. But Mr. Hill, Officiating Conservator of Forests, Pegu Circle, thinks the *Tawmengoot* is probably the *G. morella*, or *pictura*, or *gutta*, the true gamboge tree, which does not grow all over Burma like *G. elliptica* or *G. cowa*, which latter are common trees throughout the province.

In May 1884 the Commissioner of Tenasserim, drew the attention of District Officers to the trees called *Thaungthaleh* (*G. kydia*) and *Thanataw* (*G. elliptica*) found growing in the tropical forests of Martaban and Tenasserim with the view, if possible, of developing a new industry for the people. Of the former Mr. Hill says: "It yields a yellow substance of a bright colour, but paler than the gamboge of Siam. It is scarcely soluble in water, but dissolves in spirits of turpentine and affords a beautiful, permanent, yellow varnish for metallic surfaces. As the substance is very resinous and will not dissolve in water, it is valueless as a pigment." Of the latter he remarks: "The product known as *Thanataw* is obtained from *G. elliptica* or *heterandra*. It is called a superior gamboge, but in all probability merits the name almost as little as *Thaungthaleh* owing to its only partial solubility in water. It is found throughout the province and is darker in colour than *Thaungthaleh*." A sample of *Thanataw* obtained from Tavoy was found upon analysis to contain—

Resin, ...	76·5
Gum, ...	23·5

This sample was sent to Calcutta for valuation, where it was declared to be gamboge, but unsaleable in an unrefined state. In August of the same year samples of gum produced from two other kinds of trees called *Palagyi* and *Tawmengoot* were also obtained and submitted for analysis. They were found to contain—

	Palagyi.	*Tawmengoot.*
Resin, ...	58·82	53·20
Gum, ...	9·54	20·30
Water, ...	32·66	25·60

In his report on these samples Dr. Romanis, the Chemical Examiner, says the yellow kind (*Tawmengoot*) makes a very fair paint, but the other is of no use. If the gum is extracted it makes a spirit varnish, but when warm it melts and gets sticky.

According to the broker's report, to whom the sample of *Thanataw* referred to above was submitted for valuation, gamboge in its refined state sells in the Calcutta market at from Rs. 2 to Rs. 2-8 per seer. It arrives there freely from June

to August, usually packed in cases of from three to four maunds, and it is chiefly used in French polish and paint. In Burma the cost of collection alone is estimated by the Deputy Commissioner, Tavoy, at Rs. 25 per viss (3·65 lbs.) That is to say, the cost of collection amounts to nearly Rs. 7 per lb., while the market value of the product is only Rs. 1-4 per lb., and that too when it is in a refined state. It does not appear why the cost of collection is so great. In Ceylon the process of collection is very simple. There the gamboge is usually collected by cutting a thin slice of the bark of the tree here and there of the size of the palm of the hand. On the flat space thus exposed the gum collects and is scraped off when sufficiently dried. It may be possible perhaps to reduce the cost of collection. Unless it can be reduced very considerably, we cannot hope to introduce the Burma product into the market. From the enquiries made, then, it would appear that the *Tawmengoot* alone yields good gamboge, and that the only obstacle in the way of the gamboge succeeding as a commercial product is the high cost of collecting it. The products of the other trees mentioned are not promising because of their comparative insolubility in water.

RANGOON : }
The 22nd April, 1885. }

R. A. MACK,
Of the Agricultural Department.

ACTION FOR LIBEL AT HYDERABAD.—A Hyderabad correspondent writes:—The case brought by the Nizam's Forest Department against the Editor of the Urdu paper called the *Shafak* (*Anglice* "Twilight") and another, the alleged writer of the libel, came on for hearing on the 21st instant, before Colonel Campbell, in the Residency Court. The prosecution was conducted by Messrs. Forbes and O'Brien on behalf of the complainant, "Mahomed Abdul Mujeed," Meer Munshi in the Forest Conservative's office; the defence was conducted by Mr. Ookerjee. The case having been opened, the prosecution examined their witnesses, and then it was adjourned, because the defence had no witnesses ready.—*Pioneer.*

V. Notes, Queries and Extracts.

THE Madras Government have recently had under consideration *the question of modifying the orders in regard to the exercise* of the permission to hunt, shoot, and fish in Government forests generally, and with reference to "reserved lands" of the Nilgiris in particular. In this connection the following rules, under section 4 (*h*) of the Madras Forest Act (Act V. of 1882), for the Reserved Forests of the Nilgiri District, have been approved and issued by the Government of Madras :—

1. Any person who may desire to hunt, shoot, or fish within the limits of the Nilgiri reserved forests during the season in which such hunting, shooting or fishing is allowed under the Nilgiris Game and Fish Preservation Act (Madras Act II. of 1879), and the orders of Government issued under it, shall be bound to take out a yearly pass at the office of the Collector of the Nilgiris.

2. The payment to be made for each such pass will be Rs. 15, and the said pass will not be transferable. It will be available only for the currency of the calendar year to which it relates, whether it be taken out at the commencement of, or during, the year.

3. The Collector may, from time to time, by notification in the *District Gazette, declare that any particular reserved forest shall* be closed against hunting, shooting, and fishing in any year or during any portion of a year, and after the publication of such notification, no pass taken out under Rule 1, will be held to give authority to hunt, shoot, or fish in such closed reserved forests.

4. The poisoning of water or the setting of traps or snares for game in any reserved forest in the Nilgiri district is absolutely forbidden.

5. Any breach or infringement of these rules will render the offender liable to imprisonment for a term which may extend to six months, or to fine which may extend to Rs. 500, or to both, in addition to such compensation for damage done to the forest as the convicting Court may direct to be paid.

*It is to be understood that, as hitherto, the fees will be credit*ed, not to Forest Revenue, but to the Game Preservation Fund.

Mr. Gamble, Conservator of Forests, Northern Division, when recommending the adoption of the above rules, did not think that it would be possible to have one rule for both "reserved

forests", and "reserved lands," although, undoubtedly, the different penalties prescribed by the Act in one and the other case constitute a difficulty. He was of opinion that the difficulty would disappear by degrees as "reserved lands" were converted into "reserved forests." The only localities in which, in his opinion, it was advisable to stop the shooting, were those sholas which, having been lately cut over, were now under reproduction, and the plantations, many of which were fenced and easily recognised.—*Indian Agriculturist.*

ACCORDING to the *Civil and Military Gazette*, the following rules have been passed by the Maharaja of Cashmere for the regulation of shooting within his territories:—

1. Killing game without a license is prohibited throughout the dominions of His Highness the Maharaja of Cashmere and Jummoo.

2. Licenses can be obtained by Europeans from the officer on special duty, and by Natives from the Governor of Cashmere.

3. Licenses are not transferable; require renewal annually; and do not give permission to any person employed by the holder to kill game.

4. Killing game is forbidden in the province of Jummoo proper, in that part of Cashmere lying between the Sind and Lidar rivers, and in such places as are, or may hereafter be, reserved by His Highness throughout the country.

5. The destruction of the females of the following animals is prohibited—Bara-Singha, Ibex, Markhor, Ovis Ammon, Shapoo, Burhal, Thibetan Antelope, Thibetan Gazelle. The destruction of Bara-Singha stags when hornless or in velvet is also prohibited. The destruction of Yak is altogether forbidden in the dominions of His Highness. Any necessary or accidental breach of any part of this rule should be reported at once to the officer on special duty.

6. A close season, lasting from the 31st March (1st Baisak) to the 25th August (29th Sraban) inclusive, has been established for the following winged game:—Moonal, Argus, Cheer, Koklas, and Kalej Pheasants, Black and Chikor Partridges.

7. Licenses may be revoked at any time in case of infringement of these rules.

STATE OF JUMMOO AND CASHMERE.

License to kill game.

To all whom it may concern. The bearer of this license...... ....is hereby authorised to kill game in the dominions of His Highness the Maharaja of Jummoo and Cashmere, until the end of the year eighteen hundred and eighty-five, subject to the conditions printed on the back.

THE

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THE NATURE AND LIMITATION OF THE SERVITUDE AND THE OWNERSHIP-RIGHT IN FOREST ESTATES.*

INTRODUCTION.

Two very full and important papers appeared in the *Zeitschrift für Forst und Jagdwesen*, for February and March, 1884, under the title given in the note.† Dr. Brandis was good enough to put these into my hand, and suggested that an abstract of the more generally useful or universally applicable parts would be of value to forest students in India. In the following pages I have accordingly attempted the task. I make no pretension to give an exact translation, but rather a free abstract, of Dr. Danckelmann's papers; where necessary I have added (either in foot-notes or distinguished by square brackets) certain comments or explanatory remarks of my own. What I have omitted altogether are either mere repetitions (which often occur in the original) or detailed references to provincial statute books and legal decisions, or special details regarding certain forms of rights and conditions which are unknown and are never likely to exist in India.

The study of the true nature of the forest-right, its relation to the right of ownership in the forest, is one that cannot fail to be important to forest officers. It was long before the matter was fully understood in Europe, and many readers will be aware what great trouble arose, from the fact that at the time of the first French Revolution, a jurist of such great capacity and learning as PROUDHON, in his desire to overthrow all traces of feudal superiority of the aristocracy, insisted on misunderstanding the true relation of the *usager* to the forest estate and its owner; and how he actually succeeded in getting a law

* From the Original of Dr. Danckelmann, in the *Zeitschrift für Forst und Jagdwesen*, (February—March 1884).

† *Ueber die Grenzen des servitutrechts und des Eigenthumsrecht bei Waldgrund berechtigkeiten*, vom Ober forstmeister Dr. B. Danckelmann.

passed, that the *usager* was to be in fact considered as a sort of *joint-owner* with the forest proprietor, and so be entitled to demand the *partition of the forest.*

This law was repealed in 1827, and then the true nature of the right of user was recognized, but not till after considerable mischief was done, and many forests had been lost for ever to the public good. It will be well that we should not have to go through the same experience in India.

It is true that in India, we have not yet arrived at the stage when all forest estates are practically finally constituted; and when they are all of such value and so situated, that the relations between the right-holder and the forest-owner (*i.e.*, in most cases the State or some community) are matters which frequently come before the law courts for adjustment—each party being eager to appreciate and to determine the exact extent of his legal capability. Consequently, we have as yet neither definite statute law nor the authority of a series of High Court precedents on the subject.

But such questions are sure to arise sooner or later, and then we shall have to look about for the means of their solution. Where there is no provision of written law, nor any definite local custom of the tribe or race (which there could hardly be in these matters), the rule of decision is legally what is known as that of "equity and good conscience." But it has long been recognized that in order to ascertain what "equity and good conscience" with reference to the circumstances in dispute *are*, the Judge cannot refer to his own fancy, or raw-impression of what is right, but must seek for some 'authority'—must consider legal principles, and be guided by the analogy of other laws and so forth. Naturally enough, therefore, reference will be made to the opinion and practice of those countries, in which forest management has long been on a business-like and reasonable footing, and in which these questions of right have been adequately studied, and solved both in the law courts and the provisions of the statute book.

The forest officer who is able to refer the Advocate who has to argue a forest case, to some such sources of information, will enable him rightly to guide and influence the course of decision. For at present, the study of forest jurisprudence—is, owing to the virtual absence of any necessity for it—in practice hardly attempted; and there is probably, not a single Government Advocate in any province who has ever had occasion to go into the matter at all. Nor do English law books afford much assistance, because 'forests' in our sense of the word hardly exist in England, and in Scotland, where great areas have been planted, the property was absolutely free of rights. The English law principles regarding common rights—while far from ignoring the general stand-point from which such matters are regarded in other European countries—still rarely suffice to

solve those questions which arise, when it is a question of *maintaining the forest.* The perpetual danger is, that if the right is left, as the ignorant peasant would perhaps like it, undefined and unregulated, the forest itself—the substance of the estate—will suffer, and so not only the public (as the principal forest owner) suffers grevious injury, but the *right-holder himself will lose the means of satisfying his wants*, which he might have enjoyed for ever, if only a (naturally distasteful) prudence, economy and moderation, had been enforced on him. In forest as in other cases, it is easy to kill the goose that lays the golden eggs; only that in forest matters, the destruction is not accomplished in a day, and a whole generation may pass away unheeded while the work of deterioration is gradually but surely going on.

The continental nations which have large natural forests to manage, have been obliged, in the nature of things, to study the relations of the forest-owner to the forest right-holder from the necessary point of view; and as the great principles of the Roman law, which have been the source of so much of our modern jurisprudence all over the world, dealt with the question of 'servitudes' and ownership, in a singularly, clear, reasonable, and philosophical manner, it has followed almost as a matter of course, that the legal principles of rights which are recognized in the forest law of France and Germany, &c., are to a large extent expansions and applications of the Roman law.

In India, such principles will soon commend themselves to be followed, at least generally. And our circumstances are singularly well adapted to facilitate the application.

We have rarely or never any difficult cases to provide for; we have rarely or never any cases, where a right has originated in a special contract, or where it binds the forest-owner absolutely to specific terms, or where it derives additional strength from having been granted for a valuable consideration. In reality our forest rights in India, are not *legal* rights at all. Under an Oriental Government no such thing as a prescriptive right would be practically possible.

The Mogal Governor, certainly never troubled himself to interfere with wood cutting or grazing in the forest—which from his point of view was a "waste," and was (though in theory the property of the State) nevertheless only a potential property—something that might become 'property' only when appropriated by grant, cleared, and cultivated. Though, therefore, the grazing and the wood cutting might have gone on for a period of years, that far exceeded what would now be sufficient to create a prescription, the "usager" would never for a moment have dreamt of disputing his obligation to take himself away for good and all directly a "sanad" was issued by the Nawáb granting the forest to some zamindar or other grantee to be cleared and ploughed up.

Nevertheless, when western law and western ideas were ap-

plied to property and to rights in India, there was no other course possible—certainly none that would have been equitable and befitting a civilized Government than that which has in fact been followed, namely, to treat existing ancient practices and users of the forest in the matter of grazing, wood cutting, and so forth, exactly as if they were true 'servitudes' under the modern legal conception of the thing.

Under such conditions it has happened that forest-rights are in India by no means *always* rights *in rem*, or "real-rights." The text-books on the Continent always define a forest-right as one that belongs to some *estate*, and is enjoyable—never apart from that estate but—only by the direct owner or holder of the estate for the time being. There may be personal rights to one particular enjoyment (*niessbrauch*), but they are not treated on the same footing.

In India, however, we draw no distinction; and the forest-right is dealt with in practice on the same basis whether it is attached to an estate (as in the case of a right held by a Burmese monastery), or is a personal right (as that of some Kangra graziers, &c.), or attaches to a person as being a member of a village community.

One other point remains to be noted. Forest officers who have taken up the study of forest-rights warmly, may be disappointed to find, that neither the Settlement authorities, nor the Magistrates, will always recognize to the full, the principles that have been set before them in such writings as the present. But they should not be discouraged. It is absolutely necessary to understand what I may call the true or complete theory, even though circumstances do not as yet enable us to apply it frequently. No human hand can draw a perfect circle, yet we do not on that account despise the book of Euclid which treats of the properties of circles. Magistrates and Courts are not perfect, and in any case, as I have said, they are so little accustomed to deal, in practice, with questions of forest right, that it is not surprising, if they should often make mistakes, or fail to appreciate points, or imagine that a rule derived from foreign text-books is necessarily inapplicable in India. We must patiently wait for the spread of knowledge and for the practical recognition of sound principles in forest matters, and must not conclude our information to be wrong, because courts do not all at once fall in with it.

The *only* way, I repeat it, in which we can learn how to deal with disputed questions of 'owner' *versus* 'right-holder' and the like, is to see how other nations have, in their often century long practice and experience, dealt with them. And the sooner we have a body of men, who know how this is done, and at least enter into and appreciate the rational discussion of forest law questions, and grasp the real principles on which the discussion *must* proceed if it is to lead to any practical result, the sooner

shall we come to an end of those strange decisions, and that unwillingness to appreciate the necessity of forest maintenance *as well as* the convenience of the "usager," which is at present so common an obstacle, and which may lead the forest officers to despise such studies as the present, on the ground that they are unpractical and 'in the air.'*

BONN: May 1885. — B. H. BADEN-POWELL, B.C.S.

ABSTRACT TRANSLATION OF DR. DANCKELMANN'S PAPERS.

In the statute books, and even in the text-books of Civil Law in Germany, Austria and France, the boundary line between the natural province of the 'servitude' or right of user, and that of ownership is nowhere sharply drawn. The Roman law, the source of those legal conceptions regarding rights, which have been largely adopted by the different countries of Europe, took no special notice of servitudes in (or over) a forest, as a particular kind of estate. [When the Roman lawyers wrote, the idea was probably prevalent—as it still is in backward and semi-civilized countries that forest was part of the unappropriated or unowned waste—a sort of practical *res-nullius* not to be classed as "estate" at all (still less as a kind of estate having great value and importance—) over which the owners of other estates as the dominant body could exercise servitudes. Yet directly a forest becomes recognized as a property with a definite destination and purpose, just as definite as that of an orchard or a corn field, then it becomes at once noticeable that this kind of property is just *the* one, in which servitudes are most likely to come largely into play. Almost all the rights, that, in every-day life, one comes across, are either the class called "easements" regarding rights of way and flow of water, which may arise anywhere, or else are rights to get certain objects of domestic and farm utility, grazing, grass, wood, gravel, &c., which are most frequently and naturally to be found in forest estates].

In the old German law, the 'right of user' was only noticed as being *part of the owner's* own right, namely, a right to enjoy *one's own* property. But the Roman view is essentially different there, the right of user, spoken of, is the right of *one*, to make some use of the property of *another*.

The right of ownership has been raised to the conception of an exclusive, indivisible (*untheilbar*) and permanent, lawful dominion over a thing, so that the right of user or servitude, is a secondary or subordinate right.

* Occasional references to 'Eding' and 'Pfeil' in the sequel are given without the names of the books, because, they are those which are so constantly quoted in my Hand-book, and are there fully described.

The servitude affecting the soil (real servitude or prædial servitude) as recognized by the Roman law is a right attaching to a specified estate, to some user or enjoyment in respect of another estate; the owner of the latter being consequently compelled, to submit to something, or not to do something, which, otherwise, in virtue of his own right he would not have to submit to or would not have to forego.

In all cases,* the holder of the right of user is a specific estate or plot of ground, and is called the 'dominant' estate, with this meaning, that the holder for the time being of the estate may practice the right or surrender it: he may also alienate it along *with* the estate he holds, but he can never separate the right from the estate; neither so as to transfer it to another estate or plot of ground, nor hand it over to another person: he cannot even transfer the enjoyment of the right for any single occasion.

The estate which bears the burden of the right—the servient estate—is another estate, and in the case of forest right is of course a forest estate.

The immediate subjection of the servient estate, establishes the nature of the right as one *in rem*,† since it attaches or belongs to the dominant estate and subsists over the servient estate, no matter who is the owner for the time being of either, nor is it affected by any transfer or partition of either estate, nor by any entry or non-entry in a land register or title deed.

In the case of a forest right, it is not only the forest soil, but the forest,—the working combination of soil and what grows upon it,—that is the direct subject of the right: this consideration shows the necessity for a proper maintenance of the forest, in the interest alike of the right-holder, and of the forest which bears the right.

The essence of every right of user—whatever may be the particular object or faculty enjoyed—is a properly regulated, or duly economical, use of the servient property, for the permanent benefit of the dominant estate. It is in fact, a right to make some use of it, a *uti* or *frui*, but not a right touching the *substance* of the estate itself, for that belongs alone to the owner. The right of user also must fulfil some permanent object of the dominant estate, and yield a real advantage to it, and not merely serve some purpose peculiar to some particular owner for the time being. It is a principle, that a servitude which is of no real use to any one is not recognized, (*servitus quia nihil interest, non valet.*) It is on this account that, where

* *Cfr.* the remarks made on the subject in my introduction.—B. P.

† A right, *i.e.*, attaching to the thing itself, and persisting against all owners of the thing for the time being, and not merely creating an obligation in a particular person.

the servitude is not originally and in its title, defined, the *actual requirement* of the holder is the legal measure of its extent.

And so also the benefit to the right-holder must be of a permanent character, (there could not be a servitude* which happened to benefit him for a brief period and after that ceased to be of any use. (*Servitutes perpetuas causas habere debent*). And this 'perpetuity' affects both sides; for if the right is one that will always be exercised by the dominant estate, the servient estate must always be kept up so as to bear it.

When, therefore, it is said that the benefit must be perpetual, it means benefit to the direct owner and worker of the dominant estate, and not extending to other persons only indirectly connected with its primary business or purpose of existence. Also, on the other hand, which is very important for the right-holder, it means that the servient estate must be kept always in such a condition that it can bear the right and be able to fulfil the requirements both of the right-holder and of the owner. In connection with this comes in the principle that the right-holder must always exercise his right with moderation (*civiliter uti*): he must not make the satisfaction of his legitimate wants more burdensome to the estate than need be.

The servitude can never be a bar or an obstacle to the natural use and necessary destination of the servient estate (*eigentliche bestimmung*): the 'substance' of the estate cannot be attacked, nor its legitimate management and cultivation be interfered with. The enjoyment of the right or servitude, is always *salvâ substantiâ* and *salvâ culturâ*, of the servient estate.

It will be seen that all this implies, in the owner of the servient estate, a certain passive condition; in which he is obliged to submit to a proper exercise of the servitude and do nothing, on his part, which would hinder such an exercise.

It is the character of the servient estate's duty, that it consists not *in doing* anything, but in *bearing* (*in patiendo, non faciendo*), or in *foregoing* on his own part, some act which would interfere with the right of the other. The servitude does not require the servient owner to do anything (*in faciendo consistere nequit*). [For instance, a forest owner could not be required to undertake any cultural operations for the express purpose of producing something for a right-holder, that is not naturally on his estate]. There was one exception to this [rather apparent than real] in the Roman jurisprudence, and that was in the *servitus oneris ferendi*, where one man's house had the right of being supported by another's wall, and where the latter was obliged

* A temporary right existing only for the occasion, might arise out of a contract, grant, &c., &c., but it would not be of the nature of a servitude or "right of user."

consequently to keep his wall in a state of soundness and repair sufficient to afford the support required.

These Roman law principles of the servitude or right of user have been adopted into all the general laws of European nations, and may be found, for example, in the Codes of Prussia, Saxony, Austria and France. They proceed logically and follow from the Roman law theory of rights and of the relation subsisting between ownership right and the right of user. The owner has his 'dominion' over the thing, and his competence to use and to dispose of it, notwithstanding the servitude; so that he suffers no diminution of this actual competence therefrom. More clearly still the Roman view enunciates the effect of a right of user on the ownership right, as consisting in this only, that the exercise of the latter is subject only to such limitation as is necessary to the due exercise of the right; the owner must forego only such dispositions and such methods of enjoyment or using his property as would hinder or nullify the enjoyment of the right of user.*

The European Codes do not, however, give us any very satisfactory or methodical information, on the important questions of the manner in which, the extent to which (or the limits within which) the user-right is, on the one hand, to be exercised, and the ownership right, on the other, to be restricted.

This is attributable to the fact that at the time when the law of servitudes was first codified, forest rights had but a slender intrinsic value: moreover, the forest management was such that it seldom came into practical collision with the interests of right-holders.

Later on, when rights were found to interfere with the advancing ideas of forest management, laws were enacted for

* Some authorities have maintained that by the existence of a servitude, a portion of the ownership-right is, so to speak, broken off, and handed over to the right-holder: which would lead to the conclusion that in the event of a conflict of interests the right of user is the stronger, and the ownership-right would have to give way. This teaching of the *diminutio domini* is, however, contested by Schönemann as regards the Roman law (see Schönemann; Die Servituten, §§ 5. 6, Leipzig, 1866), and by Förster for the Prussian law. [The teaching objected to by our author is also commonly found in English books on Roman law, for example, if I am not mistaken, in Sandar's Justinian. All the possible acts of control, disposition and enjoyment over property, that together make up a perfect or unlimited ownership are compared to a bundle of sticks, and when one or two sticks are withdrawn and given to some one else, that is analogous to the right-holder who has *part of the* enjoyment. My own suggestion is that the two views are not inconsistent, but that they really are different aspects of the same subject—the thing regarded from two different stand-points. If you regard the perfect *use* or *enjoyment* of every stick and berry in a forest as an attribute of ownership; as in one sense, it no doubt may be called a breaking off of part of the ownership, when the enjoyment of any particular product passes into the hands of a right-holder: but the actual enjoyment of a thing is not the same as the capacity or right to own it. My capacity of locomotion is not diminished, because a high stile crosses the footpath; or because certain large stones are laid about, through which I have to pick my way].

the extinction of rights by compensation.* These laws do not, however, fully dispose of the difficulties that arise. [We shall proceed to discuss the question under two sections, 1*st*, looking to the limits which legal principles give to the *right of user*, and then 2*nd*, considering the limits which confine the *owner's* right when he has to deal with "usagers"—right-holders over his estate].

SECTION I.

The limits of the right of user, in forest right.

The question is, what lies within the sphere of the right-holder's proper user, and what outside it?

The sphere of the right is—

1. Its subject (*i.e.*, wood for building, firewood, resin, grass, &c., &c.)
2. Manner of obtaining (grazing, grass cutting, cutting trees oneself, or obtaining delivery of timber ready cut, &c.)
3. Place of exercise.
4. Time of exercise.
5. Purpose to which applied (wood for domestic fires, but not for factory forges, *e.g.*)
6. Extent (quantity and dimensions).

These matters will all be determined, either by the holder's title (whether that title is prescriptive, by grant, or by authoritative decision of the tribunals) by the law, or by local or general custom. If neither the title nor any provision of law or custom defines the right, then it is limited—(1), by the needs of the right-holder; (2), the capability of the forest; (3), the right of the owner to have his enjoyment along with the right-holder; (4), the duty of the right-holder to spare the forest estate as much as he can (*Waldschonpflicht*); and (5), the right of the forest owner to work his forest in a certain way. All these different heads will now be made the subject of remark, *seriatim*.

(a). The requirement or need of the right-holder.

The term "need" or "requirement" refers to the right-holder's want in respect of the particular object of enjoyment which the right refers to. [In a firewood right, for example, it

* For example, in Prussia, the
Landes kultur edict, ... 14th September, 1811;
also the—
Gemeinheits theilungs ordnung, .. 7th January, 1821.
Wald streu gesetz, ... 5th March, 1843.
Baden Forest law, ... 15th November, 1833.
Bavaria " " .. .. .. 28th March, 1852.
Austria " " .. .. .. 3rd December, 1852.
(Bavarian law, *see* Ganghofer, "Das Forstgesetz, &c., in neuer textirung vom Jahre 1879," Augsburg 1880).

means the estate owner's requirement in the matter *of fuel*, whether that fuel can be claimed for domestic hearths, for forges or furnaces, for kilns and so forth, or for two or more, or all, of these, according to the nature of the right]. In defined rights, the quantity or extent is already settled either by the original title or by subsequent action. It is in indefinite rights, that the 'requirement' of the right-holder must be referred to as the standard. This follows from the Roman law theory of right, and is also deducible from the old German customary law. The right being inseparable from the dominant estate, it follows that what is needed for the estate is the limit of the right.* As a corollary also, it follows that the produce of rights cannot be sold (because if there were an excess available to sell, that would imply that the right-holder had taken more than he needed), nor can it be applied to other purposes, than to the supply of (*a*), the working of the estate ; and (*b*), the supply of the household of the estate owner.†

On this subject an important question arises, *viz.*, Whether the wants of the right-holder extend to the total requirement, without regard to other means of satisfying it which the estate may have apart from the servient estate : or whether the right is confined only to the balance which the estate cannot get from such other sources : this question may arise in two cases : one where the estate has rights over several forests, another where the estate has some forest of its own, from which a part, at least, of the requirement might possibly be met.

The laws usually contain no direct provision regarding taking account of the means already possessed by the estate. The matter is then determined by the original title, and with reference to the former practice [as it can be ascertained to have all along been followed] in the exercise of the right.

In the French law for compensation of rights (still in force in Alsace and Lorraine, 19th May, 1857), Art. 8 provides, that in compensatory rights, the material which the right-holder possesses in his own forests is not to be deducted from the total he can claim from the servient estate, unless it is expressly so provided in his title, or has in fact been done in the previous exercise of his right. In cases where a deduction has to be made, the further question arises, on what principle the deduction is to be calculated ; it may either be the entire yield of the other places of resource, or only a quantity, proportionate to the yield-capability of the servient estate as compared with that of the other sources of supply.

* [Suppose a house *x* holds a fuel right for its domestic hearths : there are ten such hearths in the house. The requirement of such estate is then fuel for ten hearths and no more ; and we have only to ascertain what kind and quantity of wood fuel is reasonably and conveniently sufficient for each hearth *per annum*, and we have defined the right].

† *Cfr.* Windscheid. Lehrbuch des Pandectenrechts, §209, 3 Aufl, 1878.

[The "proportionate" method of deducting the amount of satisfaction obtained from other sources, is in theory the fairest; but it can be applied only in some cases, and its application, apart from inherent difficulties, may also be determined by special terms and conditions of the right-holder's title. It is usually applied in calculating the "need" of an estate in the case of grazing rights, and may be also in the case of firewood rights.

An example will make clear what is meant.

Supposing A is the servient estate, burdened with an undefined grazing right of the cattle of farm X. For the working of X according to a natural, and locally-usual method of managing a farm of the size and character, 210 head of cattle is the full 'requirement.' But besides a right over A, (which might thus conceivably extend to grazing 210 cattle but not more,) X has also a grazing ground of its own, which we will call B. Supposing the right to be such, that either according to title, or to law, or to equitable decision, A is not to be burdened with the entire need (*i.e.*, of the whole 210 cattle) irrespective of the right-holder's other means of meeting his grazing requirements, but is only entitled to be burdened with the unprovided for *balance* of the need. Now B actually is capable of affording grazing for 200 cattle,* so that if the deduction is made on the principle of taking the *total* capability of the other resource (*voller ertrag*), then the right over A, would only be taken as grazing for $210 - 200 = 10$ head of cattle. But if the principle of *proportionate* deduction were adopted (as it probably ought to be in such a case), then we have to consider, that while the servient estate A has a capacity of supporting (say) 100 head of cattle, B (as above) has a similar capacity of supporting 200; in other words, the proportionate supporting-capacity of B (the right-holder's other resource) to A (the servient estate in question) is as 2 : 1. Then in deducting the *proportionate* value of the resource B, we should say that B must bear 140 and A 70 ($140 + 70 = 210$ = the total number of cattle), or in other words, that from the gross 'requirement' (210) claimed against A, a proportionate deduction of 140 must be made for the resource B, leaving the right to be satisfied on A as 70].

[It may not always be easy to determine whether in estimating the requirement of any estate, *any* deduction should be made for other means of satisfying it. In most cases such resources no doubt *would* be equitably taken into consideration. And a *proportionate* deduction (in the sense just explained), rather than the full yield of the other resource, would be preferred on

* This will of course be ascertainable, either by calculating the number of acres that will support one head, or by this as modified by considerations of actual yield of grass and so forth.

grazing and other rights where it is possible. But these are after all matters of detail, and what is of the greatest importance is to see that the amount of need or requirement is fairly fixed, with especial reference to what has been hitherto the practical extent of the *right*, supposing it to have been exercised in a fair and reasonable manner, such as the real necessities of the dominant estate warranted, and the local custom justified].

It is also an important point to determine, in estimating the actual requirement of the right-holder, what date or standard time shall be selected as that for which the requirement is to be noted. For the requirement as it is to-day may be very different from what it was 5 years ago, or 20 years ago. Changes may have taken place in the manner of cultivation and in other local conditions. Must we then look to the amount of the requirement as it (changefully perhaps) exists at present, or at any other given moment of time, or to the need *as it existed at the date when the right originated?*

The Prussian law draws a distinction in this respect between servitudes which are prescriptive and those which originated in grant or contract. In the former, the maxim is *quantum possessum tantum præscriptum* [whatever has been the fixed or average quantity during the period of years which constitutes the term of prescription]. Not so with rights originating in grant or contract, then the requirement of the time being is taken: and if the circumstances have changed, the need may have increased, or expanded (timber for house-building may be required in larger or in less quantity, or in longer or shorter dimensions, owing to change in style of building, &c.) But it is to be understood, that the changes which are allowed to effect the requirement, are natural and legitimate changes, not such as arise from a total alteration in the management and destination of the estate, or in unusual and extraordinary dispositions and arrangements of its working system. [This seems only reasonable, because when a right is created by contract or grant, it is only natural to conclude that the grantor foresaw what was probable according to the usual course of nature, and intended, that if *e. g.*, he granted "building wood for a dwelling house"—it should be such a dwelling house as the custom and style of the time being would necessitate, if otherwise, he could have restricted it. But in the case of a right which has been merely recognized by prescription, no such foresight or intention can be supposed, hence the true measure of the need of the right-holder is only what he actually had during the term when the prescription title was growing].

(*b*). *The yield power of the forest.*

If the yield of the forest is sufficient to satisfy all the properly determined claims of the right-holders, *inclusive* of the wants of the forest owner, then there is nothing more to consider than

the delivery or supply by the quantity fixed by the title, in the case of defined rights, and of that fixed according to the requirements of the right-holder, in the case of undefined rights, as set forth in the preceding paragraphs.

But it may be that the normal yield of the forest when its existing stock is managed on proper principles of permanent management is unequal to the full task. In that case, unless the forest owner has himself wrongfully caused the deficiency, or there is some special title, otherwise the right-holder must submit to a proportionate reduction in the quantity of his produce, [otherwise the right would not be exercised *salvâ substantiâ*—an attack would be made on the capital when a man demanded more than the actual income or interest of it.] Of course no compensation can be asked for such a reduction.

The owner of the forest is never responsible if the insufficiency of the forest yield is due to accident, or "vis major;" as for example, to damage from wind, snow, insects or forest fires; and of course also not when the deficiency has been caused by the exercise of forest rights, through the increase of their quantity or the demand made on the forest by them.

But if the forest owner has wrongfully brought about the deficiency, the forest right-holder can claim compensation: as for example, in the case of over-cutting, or neglect of reproduction, wasting or uprooting the forest or general mismanagement.*

The owner is also responsible if he creates new forest rights, to the prejudice of the older right-holders, or injures the rights by an improper change in the management of the state, (*e. g.*, changing forest into agricultural land.)

Should the owner be bound by any express title to find the right-holder a fixed quantity of material under all circumstances, then he is responsible, because he has chosen to make himself so by the terms of the title. The Prussian law courts have laid it down (as is also expressed in Art. 65 of the French Forest Code) that the right is not an *absolute* one, to a fixed quantity or to a quantity definable according to the standard of need, but a *relative* right, dependent, *i.e.*, on the capability of the forest, with reference to the principles of regular and scientific forest management.

The Bavarian law of 1852 (Art. 25) contains express provisions that when forest rights interfere with a permanent regular management, the owner can claim a definite moderation (or regulation) of them for a given time, without any compensation; provided of course, that the necessity for such action does not arise from his own faulty management.

* This latter has been expressly recognized by the Prussian "Obertribunal," (including a wrongful neglect to cultivate the forest) as a ground for complaint on the part of the right-holder.

One point remains, namely, when several forest rights of the same kind exist concurrently and the rights have to be reduced, whether all are to be reduced equally, or not, and if not, on what principle one or other is to have the preference.

The correct principle seems to be that rights having the same date of origin, whether prescriptive or arising out of contract or grant, whether defined or undefined, are on the same footing, and must be reduced equally.

But if their date of origin is different, —some earlier, some later,—then we have to consider whether the failure in the capability of the forest arose after or before the date of origin of any of them :

(1), it may go back to a period before any of the rights originated ;

(2), it may be after the older rights and in consequence of the new ones coming in to burden the estate ;

(3), it may be after the older rights arose and before the new ones, but not *in consequence* of the demands arising from the latter.

In the (1) case, all rights will be reduced or regulated equally : in the (2) the new rights alone will be reduced : and in the (3) the new ones go first altogether,* and the older ones only when a further reduction is still necessary.

(c). *The concurrent right of the owner to use the forest along with the right-holders ('mitnutzungsrecht').*

The German laws recognize as a principle resulting from the nature of ownership and of the servitude, that the owner has always a concurrent right of enjoyment along with the right-holder, unless the latter has acquired some very special and express title to exclude him.

No doubt can, indeed, exist about this in case the produce of the forest estate is sufficient. But if it is deficient ; then the laws of different countries deal differently, and even in contradiction one to another, with the question.

A general comparison of the laws, taking also into consideration generally admitted legal principles, tends to the following conclusions :—

(a). *Cases where the right-holder has the preference.*—This is admitted in the case of original or ancient (*ursprünglich*) real servitudes, defined as to their extent and mode of exercise,† when there has been any fault of the owner tending to produce the deficiency, even undefined rights have the preference, (such as, excessive working by the owner, creation of new rights, ill-considered changes in the management, &c.)

* Except indeed when the new ones are by prescription, and the prescription has run as well against the older right-holders as against the owner.

† And not those of ancient origin, but undefined, and only in later times fixed and made definite.

(*b*). *Cases where the owner has the preference.*—It must be remembered, that in order to secure the permanent satisfaction of forest rights, as well as to keep up the forest itself, it is indispensable to protect, manage, work and cultivate, the forest in a proper manner; and this costs money: the produce of the forest, of all kinds, is the natural source, whenever this expense can be met. It is, therefore, not unreasonable that the forest produce available to satisfy rights, should meet this expense, at least in so far as the rest of the produce is inadequate to do so. (Of course, it is assumed that the inadequacy is not due to the forest owner's own fault). It follows for instance, that when forest officials have to be paid or found in certain quantities of forest produce, in return for their services in the forest, that this payment should come from both right-holders and owners, since both are benefitted by it. The forest owner may therefore satisfy such demands out of the forest produce before any one else of the right-holders can get his dues.

(*c*). *Cases where the right-holder and the owner have equal claim to the produce.*—Where there are original undefined rights, (even though they may have subsequently become defined,) the right-holder has an equal but not a superior right to share the produce with the owner, according to the wants* of each.

[The reason of this distinction between originally defined and originally undefined rights seems clear. When in ancient times, a defined and fixed right was granted, it was clearly the intention of the owner to suffer the right independently of his own satisfaction, either he knew that the forest would suffice for both, or he deliberately chose to grant the fixed quantity unconditionally, and without reservation for his own convenience.

[Where, however, the right merely grew up in an undefined way, on sufferance, and without special grant, no intention of the owner to exclude his own natural enjoyment can be inferred].

If the produce is insufficient, both parties suffer an equal diminution.

These principles are not always admitted, and some authors controvert them, *e. g.*, Von Bangerow Lehrbuch der Pandecten, (§ 340, Anm., 2, 4), 7 Auflege, 1863. Windscheid also, § 209, pages 296-9.

(*d*). *The duty of the right-holder to care for or to spare the forest ('waldschonpflicht').*

Besides the restriction of rights to the wants of the right-holder, to the capabilities of the forest and with reference to a (possible) concurrent right of enjoyment residing in the forest

* Wants, *i. e.*, after accounting for other means of partially satisfying it, which either may possess.

owner, the duty of the right-holder to enjoy his rights without destroying the forest, is always to be enforced, by regulations in respect of locality, season, and manner of exercise.

This follows from the nature of a forest right, which is one of using the produce, but not extending to the substance of the servient* estate.

Such a principle is well expressed in Art. 80 of Theil I., Tit. 22, of the Prussian Landrecht, which runs as follows :—

"Whoever has the right to keep (*hüten*) his cattle on the soil of another, must make use of that soil so that the owner of it, suffers no damage in the substance of his estate, and so that he is not hindered in the usual cultivation and utilization of the land according to its nature."

And in §241 :—

"The right to dig earth, stone, or clay, &c., on another person's ground must always be so exercised that cultivated fields, grass meadows, pens and folds and trees, suffer no injury thereby."

In case of all wood-rights, these depend on the continued existence in a capable state, of the forest, for otherwise there would be no *perpetua causa* for the right, which the received principle recognizes as necessary in the case of a servitude. It is then obvious that the wood right can only be so exercised as not to interfere with the regular and continuous yield of the forest. An uncontrolled, irregular, and uncertain cutting by right-holders would certainly result in the deterioration and ultimate loss of the forest itself.

It is true that the case stands otherwise with rights to grazing, to grass, and to collecting herbage under the trees, for these are likely in many cases to increase, the fewer trees there are. [But still the right-holder must spare the estate ; he cannot separate the parts and say he will take care of the soil-substance, but has no business to care for the trees—for the forest is one whole—soil and trees ; one cannot be taken apart from the other]. All laws, however, expressly provide that rights of this class must be so exercised as not to interfere with the management of the estate as a whole. Nor can the grazing-right-holder, for instance, say—'there was only such and such a stock on the ground when my right originated, you cannot improve your forest and increase the stock.' Because the continuous filling up of blanks and restoration and improvement of a forest till it reaches the best possible condition, *proper to a forest of that kind and class*, is naturally part of a good and reasonable management of every forest estate, and this cannot be hindered.

* [Even a turf cutting right, or a right of digging gravel, is such, though in strict theory it involves a diminution of the actual soil mass. But in practice turf forms again, and is therefore much more analogous to produce and even gravel, though not reproduced, does not practically injure the estate : no one could have a right to take such large quantities of gravel or soil as to convert the removal of the forest into a great pit].

The Prussian Landrecht specially provides that where a right can be exercised, equally well for the right-holder in more ways than one, that way is to be selected which is least burdensome or least to the detriment of the servient estate.

The extent of the restriction which is imposed on the right-holder, for the safety of the forest, is expressed in the regulation, as regards *locality, season, and manner of exercising* each right. In order to facilitate the protection of the estate, certain rights may be restricted in their exercise to particular seasons or even to certain fixed days.

All these matters are provided for in special laws.

[I do not go into detail in this part of the paper, as there is nothing new; and what is mentioned will be already found in my Handbook of Forest Jurisprudence].

(e). The owner's right of working his forest.

In the same legal principle as that which compels the right-holder to spare the forest, the forest owner has the right to have his forest worked always in a proper scientific manner, this right is only limited by the necessity of providing for the due exercise of the existing rights.

The owner's right consists in freedom to do—

(1), all acts of ownership that do not touch the servitude right in any way at all;

(2), acts which do affect the right to some extent, but are requisite to maintain the forest itself (*Wald-substanz*), or to accomplish the natural purpose and destination of the forest, or are demanded by the rules of a regular forest working: also any acts or practices which are usual in the locality where the forest is situate; or measures which were being taken (according to the state of the forest) at the time when the rights originated.*

This submission of the right-holder, follows from the definition of a right, that the owner has the totality of rights in his estate except only in so far as the right of the servitude holder to his own enjoyment, limits him. A servitude takes away from the owner, no capability, or faculty of action except that which would interfere with the enjoyment of the servitude.

The right of the servitude holder to have the forest (the substance of the estate) maintained so as to serve his purpose corresponds to the right which the owner has, on his side, to keep his forest in a good condition. The 'substance' of the forest, consists, as we have said, of the soil, and the surface growth; and as parts of the surface growth must be considered, all arrangements and groupings of the growing stock, the age

* Unless of course there was an express title granted with the right, or become prescriptive afterwards to forbid any particular act on the part of the owner.

classes, &c., which result from the method of working the forest and its arrangement on a periodic plan of cutting with reference to its reproduction in a given term of years. Part of the right to maintain the forest is the right to maintain it in a condition to fulfil effectively and completely its normal, natural and proper purpose. The natural purpose of a forest is the abundant production of wood: the existing state of the forest may not be such as to fulfil this object; and in such case the right-holders must submit to restrictions necessitated by such changes in the forest as will tend to secure the establishment of the desired conditions.

This is expressly provided for in the Bavarian law.* It follows that if the 'substance' of the forest is to be maintained, and that in such degree that a complete wood-production (as the normal object of a forest estate) can be satisfactorily attained, the owner must have the right, and the right-holder be bound to submit to a *regulated forest-working scheme* or *system*. For under the head of "the maintenance of the forest" come the arrangements necessary for securing a continuous supply of wood fit to cut; the continuous reproduction of wood in place of that cut and carried away, the protection of the estate against injury from wind and weather, by means of a fixed method in, and direction of, the lines of felling: and under the head of "fulfilling the normal purpose of the forest estate" come, the utilization of the wood before it rots or deteriorates, the filling up of blanks, and the selection of different kinds of trees, adapted to flourish in the different parts of the forest, according to their soil, exposure, and so forth.

All these matters together constitute the aim and object of a regulated *forest-working system*.

All the chief laws, therefore, contain provisions† that the exercise of forest-rights can never interfere with a properly regulated system of forest working. In all cases the forest right-holder has no claim to compensation, unless indeed the necessity for any measures, which specially restrict his right, has directly arisen from the neglect or wrong doing of the forest owner.

The *standard of forest management*—the standard condition of forest, which the owner is entitled to attain to, and for the attainment of which the exercise of forest rights has to be regulated, is the condition of the forest (according to the custom of the locality thereof) which existed at the time of the origin of the forest servitudes.

* This law also provides that if the right-holder thinks the changes and other operations undertaken by the owner, are going too far, or are more than his right of due maintenance warrants; application may be made to the forest authorities who are to determine the question, and determine what, if any, compensation is to be given to the right-holder.

† *Cfr.*, for example, the precise terms of Art. 24 of the Bavarian law of 1852.

It is obvious, for instance, that if a deciduous coppice with sparse standards and with much space for pasture, were converted (according to a method of treatment since become general in any locality) into a coniferous high forest, the grazing right would become almost worthless. And so might a forest of beech firewood growth be converted, to the destruction of the rights of pawnage (feeding pigs on the beech-mast). But such changes of the forest to something *quite different to what it originally was* (at the time of the origin of the right) would be to ignore both the inherent constituents of the right, and also the legal principles, which we have already noticed, and which are that the owner must abstain from acts, which interfere with, or nullify, the enjoyment of the right; and that all acts of the owner, other than those of the usual cultural kind, are only admissible when they do not diminish the just enjoyment of the right-holder.

It is only fair then to consider the original character of the forest, as a standard, and allow the owner to maintain and to improve within those lines; but not to change and entirely alter the sort of forest, so as to harass the right-holders.

The parts or elements of a *system of working*, which may each demand a few words of special notice, are the following :—

(*a*). *Laying down of a working-scheme to be systematically followed out in the future.*—The condition of the tree growth, and the production of the material of the forest is secured by this.

In every working-scheme, both time and place, method, aim, and purpose of working, are laid down, and the limits of the possible annual yield are fixed; and thus obviously, the safety of the 'substance' of the forest and the fulfilment of its natural purpose and destination, are alike secured.

Wherever such a scheme, duly considered, of necessity, touches the enjoyment of a right in quantity, extent, or in its locality, the right of user, must—to the requisite degree—give way.

If there has not been hitherto a regular working system introduced, the forest owner can at any time introduce one.*

[It should be borne in mind that it is generally, if not always, possible to arrange a working scheme with special reference to rights of user, provided of course that those rights are not so excessive, that it becomes impossible to provide the quantity of wood, &c., they demand without exceeding the regulated yield of the forest, or without having such an area open to grazing as would make it impossible to keep the requisite proportion of the area under young growth and seedlings, &c.]

(*b*). *Right to cut the wood.*—The successive production of

* See this laid down in the Prussian Landrecht, Tit. 22, Part I., Art. 171. And the new order must of course be arranged so as to provide for existing grazing rights, as far as possible.

wood to be cut and removed and the cutting of the same, is part of the 'natural destination' of every forest, and is the aim and end of every well considered working-scheme. No right-holder can, therefore, prevent this. The utilization of the wood of course implies the removal of all that comes to maturity [materially, that is, for its special object and designation, as firewood, hop-poles, building wood, &c.], and before it begins to deteriorate, spoil, or lose value.

The right-holder, who likes to see all beech-mast*-bearing trees (for example) left to stand, cannot object to such necessary cutting. Nor is the forest owner bound to leave old stems to decay and fall or break off; or stems that ought to be thinned out, to wither and die; in order that the right-holder to dead and fallen wood may have something to fill his sacks with.

Rights to dead wood and fallen stems, are after all essentially gratuitous rights, and are dependent on the *casual existence* of *such wood;* and no forest owner can be compelled to work his forest so badly as to secure the existence of a quantity of it. The holder of such a right must have known all along, that where there is not a great excess of forest production,—which makes care and regulated working of the whole impossible or unnecessary,—the forest owner, if he works his forest in a reasonable manner, can almost entirely obviate the existence of decaying and falling stems and branches.

When such rights are formally extinguished by process of law, it is a question of the precise origin and circumstances of the right and the actual facts of its exercise whether any compensation is due, or whether the forest owner would be forced at least to find a certain quantity of cut standing firewood in lieu of it,† or himself to cut and deliver the dead stems found in a thinning or "forest cleaning."

(*c*). *Right to secure reproduction.*—The forest right-holder must submit to such restrictions as are imposed by the necessity of reproducing an area cut over, and also of planting up the blanks in a forest‡ (in the absence at least of a special title otherwise). This planting up can always be done gradually, and with respect to the requirements of the grazing rights.

(*d*). *Right to protect the forest.*—This right finds illustration in the provisions which special laws contain to prevent the destruction of the forest soil by the exercise of the right of raking up the humus, &c.; or those for closing areas covered with young growth against grazing rights, and such like.

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* Thus Art. 176 of the Part I., Tit. 22, Prussian Landrecht—

"The holder of a right to beech-mast, cannot object to the owner, and other wood-right-holders, cutting trees that produce the mast, when such cutting is according to the rules of forest working" (*forstmässig*). This means that every thing may be cut, because it is mature, or to prevent deterioration, or to secure the development of standing growth, or the reproduction of the forest.

† See on this subject, Eding, page 133. Also Pfeil, page 108.

‡ As expressly decided by the Prussian Obertribunal in December 1857.

(*e*). *Right to 'locate' the user or assign its exercise on certain specified portions of the forest.*—Rights are regulated as to their place, season, and time of exercise, and various special laws* are to be found which require that no right-holder should exercise his right without notice to the owner, so that he can be supervised; or that certain days are fixed, or areas determined for the exercise of certain produce rights.

It often happens that by the original title, or by the nature and circumstances of the right itself, the exercise is necessarily confined to a certain place; then of course that has to be attended to; but even so the French law (Code Civil, Art. 701) goes so far as to allow the forest owner, to assign a different place for the exercise, provided that the right can still be exercised to the holder's reasonable convenience, and that changed circumstances have rendered the right as originally located unduly burdensome to the forest owner, or a real hindrance to rational improvement.

Section II.

The limit of the forest owner's right with reference to forest servitudes.

Servitudes, as we have seen, entail certain limitations in the exercise of the right of ownership of the servient estate. These limitations consist in the obligation, to *suffer* or *permit* something, to *forego* some action, and even (exceptionally) to *do* something. The owner must *suffer* or permit the due exercise of the right. The limits of a due exercise of a right of user were considered in Section I. The owner must *forego* such acts as would prejudice the reasonable enjoyment of the right. Such acts may be in the course of *forest working*, or in the course of a *concurrent enjoyment* of the forest yield along with the right-holder. And we shall ascertain the limits of the owner's right by giving a proper answer to the question—What sort of acts must the owner pretermit, in order to avoid any illegal trespass on the province of the right-holder? As to the exceptional obligation of the forest owner to do something for the right-holder, that, as we have seen, consists solely in his being bound to *maintain the forest*, as the *perpetua causa*, or permanent source of satisfying or supplying the right.

We have then to consider the limitation of the owner's right under the three heads—(1), of the right of working and management; (2), of the owner's concurrent enjoyment along with the right-holder (*mitnutzung*); and (3), of the duty of maintaining a forest in a condition capable of satisfying the right.

1. *Limitation of the right of working and management.*—Within the meaning of forest working and management are all

* Compare, for instance, Arts 79, 112, 120 of the French Forest Code.

measures, having for their object, the utilization of the forest, and getting therefrom its due yield of produce, namely, the devising of working-schemes, the regulation of the yield, the disposition of species of tree determining the method of management, fixing the period of rotation, establishment, in a particular form, or disposition of the growing stock, cultural and growth-treatment (thinning, pruning, irrigating, &c.), protection of the forest, and also utilizing and converting into money the various products of the forest. A perfectly unfettered forest management, would in all these matters, have an unrestrained action on every part of the "substance" of the forest. Not so a forest management burdened with rights. Such a forest can only be managed and worked within certain limits, which we have now to define. Inside this line of limitation are the measures which are within the owner's legitimate "management-right;" outside it, are acts of management which are inadmissible and must be foregone.

Generally, as we have already seen, the right of management *includes* all measures which do not really interfere with the servitude, or even if they do, to some extent interfere with or diminish it, are still admissible, because they do not involve any change in the character of the estate, or the method of its management as there existed when the right originated, or because they are absolutely indispensable to the maintenance of the forest as such, and necessary to enable its natural purpose and destination to be attained.

For instance, a forest owner would be entitled to cut out his wood and thin his forest, according to a reasonable and recognized, workmanlike method, even though by so doing he should much diminish the quantity of dead stems and rotten wood, which a holder of the right to fallen and dead wood might otherwise obtain.*

Taking now the other side of the question, the owner's right of management, with respect to opposing rights of user, does *not extend* to, or *excludes*, such measures of management and cultivation, in themselves prejudicial to the servitude, as involve changes in the original† character *(bestandsart)* and method of management of the forest—such changes not being *indispensable* to the maintenance of the forest, or to its continued utility, or to its reasonable, workmanlike, management, but being merely *desirable*, with a view of enhancing the forest yield or furthering certain special objects and ambitions of the owner's.

* The only claim to compensation in such a case would be one we need hardly take any practical cognisance of, (but which is conceivable,) only when a special contract, or its equivalent, had led a right-holder to suppose a permanent supply of a certain quantity of dead wood, &c.

† By 'original,' is here meant, the class, style, and condition of the forest as it was at the time when the right of user originated.

All this follows from the nature of a right, when it is remembered, that permanence or durability is an essential element. The dominant estate has a permanent, regular, need or requirement or advantage to be claimed; the servient estate a permanent working condition, capable of satisfying that need, or yielding the advantage. The owner cannot, therefore, arbitrarily introduce a new character and form of management, still less, a change in the very nature of his estate, such as would render it no longer possible to satisfy in any reasonable manner the just demands of the right-holder.* He can only make changes when they are demanded by the actual maintenance, not the mere improvement, of the forest,† or by the requirements of a reasonable working (as when a forest has been heretofore worked at haphazard without a serial system of felling compartments, and so forth, and these are now introduced), or in order to enable the forest to fulfil its natural and proper destination.

Eding‡ has also considered that in a forest subject to rights of pawnage (acorns or beech-mast) an owner could not introduce new methods of cultivation, *merely* to get a larger income from his forest, to the prejudice of the right-holders.

Various modern laws have enacted special provisions as to the remedy which the right-holder has in case the owner oversteps his legitimate action in dealing with the estate. Such remedies may consist in either a compulsory restoration of the *status quo ante*, or of giving compensation in money, or in kind, as where (under the Prussian Landrecht) a forest owner who has taken such steps to remove all dead and fallen wood, that right-holders entitled to those materials can get none, is compelled to furnish an equivalent supply of cut standing wood, if that is possible, and if not to pay in money.

The excess on the owner's part is likely to happen—(1), through clearing of the forest and converting it to arable or building land; (2), wasteful working without care for reproduction; (3), changing the species; (4), changing the method

* Nor could he do so even though such a change had become very general in other unburdened estates, owing to a general progress in economic knowledge, or a general change in the demands of the market. Only would it be admissible, in the conceivable but not practically likely case, when an old standing form of forest had become absolutely valueless, and when a change to some other kind of forest growth is really indispensable.

† [But the term "mere improvement" requires to be guarded carefully, especially for Indian Students. It is possible to *improve* almost any forest, even though it is in a presently satisfactory condition and under orderly management: and it is to such cases that our author refers. We must not understand that rights can stand in the way of "improvement" of a kind which consists in substituting a well-grown stock for a badly grown one, a methodical management for a haphazard one, and so forth].

‡ Eding, page 98.

of felling, &c., (5), shortening the term of rotation; (6), measures for cultural treatment of the growing stock.

The laws of many European States provide in some cases for prohibiting the *clearing of forests*, on the part of the owner.

Changes in the forest species, e. g., an oak or beech forest into a coniferous forest (to the prejudice of pawnage-rights) or introducing beech and spruce, in the place of oaks or Scotch fir, to the prejudice of grazing rights, are not allowed. Unless indeed they are unavoidable and without any fault of the forest owner: as when a soil has lost fertility or its former degree of moisture, or has become impoverished by the exercise of *streu* rights, so that it can no longer properly support a growth of the original species.

Such changes are not admissible merely in order to increase the value of the produce; and it would seem that the right-holder would have to be compensated, even where the change was consistent with good forestry—though not absolutely essential; for example, an existing beech-fuel forest may become almost valueless, owing to the neighbouring cheap production of coal: here it would be most advantageous to convert it into a coniferous forest. No doubt the forest owner could in such a case demand to be allowed to buy out the right, or to furnish some equivalent for it; but still in principle the respect for the existence of the right, even under these rather extreme circumstances, is recognized.

Changes in the mode of working, may affect rights very much. A change from regular compartment felling to selection felling implies, a general admixture of ages all over the forest and consequent carrying out of cuttings over the whole area, and the springing up of young growth, which may be inconvenient for grazing. A change from high forest to coppice, may almost destroy rights of pawnage and rights to *streu*. Such changes would not be permissible, unless indeed, owing to former neglect, some method of cutting had been hitherto allowed, which was, in the particular locality, &c., contrary to forest principles, and the necessities of a reasonable forest management demanded the change.

Some decisions of the Courts had gone so far as to allow the right-holder no power of objecting, when the owner adopted a management which prejudiced his right, but which recognized as a desirable *(zweckmässig)* one by the principles of forest science; but such decisions go too far, and the more just conclusion seems to be, that the owner may always do what is really *necessary* for a good and proper working of his forest, or may substitute a regular working for a hitherto irregular one: but he cannot adopt any and every measure, which is merely '*desirable*' or 'highly profitable' according to an advanced standard of forest working, to the prejudice of right-holders.

Shortening of the rotation.—This may be in some cases desir-

able, but as it never comes within the scope of an absolute *necessity* for proper regular working, it can never be attempted without compensation to the right-holder.

Measures for the promotion of growth (thinning, pruning, cutting to let in light, &c.) Whether they are admissible or not, if they tend to diminish or nullify rights of user, depends on whether they are really indispensable for a proper management, or whether they *can* be dispensed with, or carried out gradually or in a modified manner. The question of thinning presents some difficulty, because, a forest *can* do without thinning: nature will kill off the suppressed and over-crowded stems, and thinning after all only assists and expedites the processes of nature. It would appear then that while a forest owner cannot be asked altogether to forego thinnings, he can be required to regulate them so as to leave something for the right-holder to dry stems.* [A distinction may in practice be drawn between thinnings that are fairly classed as *necessary*, and those which can only be called *desirable*].

The same principle may be applied in the case of prunings of living branches, which may be so effected as entirely to remove all chance of a right-holder finding any dead branches or fallen wood.

2. *Limitation of the owner's right of concurrent enjoyment along with the right of user.*—The owner has, as we have seen, not only his obvious claim to the surplus, which remains after the right is satisfied, but also, when the produce is not more than sufficient he can claim, to *deduct first* what must go to pay for the control and supervision of the forest, and in the case of indefinitely granted rights can claim a *concurrent* enjoyment along with those rights. When the right is *ab origine*, defined, and the produce is not more than sufficient, then it takes precedence of the owner's concurrent use. The owner must not create new rights to the prejudice of those already in existence.

The owner may have a concurrent right of grazing his own cattle along with those of the right-holder, but would not be allowed to cut the grass for his own use.

[The author here has a number of paragraphs regarding rights to dead wood lying (*Lexholz*) and to the leavings after fellings (*Abraum*) in certain cases. As the former right is both rare and unimportant in India, and the latter unknown, it would serve no useful purpose to reproduce the remarks at pages 134-136 of the original].

3. *Duty of the owner to maintain his forest.*—According to the legal notion of a servitude, the limitation which such a right imposes on the holder of the servient estate consists only in this, that the owner must *suffer* the right-holder to use the estate for

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* *Cft*. Roth., § 284, page 283.

the purposes of his right: and he must forego all such acts as interfere with, or diminish, or nullify the right. On the other hand, a right of user does not (ordinarily) require the estate-owner (actively) *to do* anything in the interest of the right. (*Servitus in faciendo consistere nequit*). This principle admits of one exception, to this extent that in some cases the very nature of the right or servitude requires the owner *to maintain* the servient property in a condition fit to serve the purpose of the right-holder. In this case with the right *in rem*, is mingled a certain element of personal obligation on the estate owner, *viz.*, the obligation to maintain. The Roman law already recognized this in the servitude *oneris ferendi*, as when the owner of a (servient) wall or pillar was found to give its support to an adjoining (dominant) building, here the servient owner might be bound (actively) to keep the wall or pillar in a sound and support-giving condition.

This principle has been adopted into various modern laws, in some cases the owner bearing the entire burden, in others, sharing it with the right-holder. The cases of right created by contract for a consideration, where the servient property is not in a condition to support the right, the owner alone is bound to restore it, unless indeed the cause of the failure is accident or *vis major* (beyond the control of the owner). And so where a right of way has been conceded by agreement, the owner of the soil may have to maintain the roadway in a suitable condition.

In cases where the right-holder is bound to contribute, it is always where both he and the owner, have the right to enjoy together, the same thing; or where the damage to be repaired has been caused by accident or *vis major*, and is equitably no more to fall on the owner than on the right-holder, but should be shared by both.

In the case of forest rights, however, the principle of sharing a contribution on the right-holder's part, has no application; only that of the owner's duty of maintenance is in question. The duty of maintenance is different according to the nature and object of the forest right. In this respect it is important to distinguish between rights which affect the forest soil and those which touch only the upper growth, *viz.*, the stock of trees. In those which affect the soil, such as grazing rights, turf cutting, grass cutting, heather cutting, &c., the condition of the tree growth is generally of no importance; indeed, the less well stocked the forest is, the larger will be the amount of available material.

But the forest owner is in no way bound to keep his forest in an ill-stocked and semi-productive condition merely to benefit the grass rights, &c.

[This, it should be observed, is true when the whole area is forest, and would naturally—as forest—be equally well stocked;

but cases are conceivable, where rights might exist in such a manner, that the estate owner would be bound to maintain a form of management in which the surface is partly devoted to trees and partly to turf for grazing as the principal object of each part].

The right of user is here subordinate to the right to maintain the estate in proper working order for the purpose of fulfilling its primary function. Only the owner must, as we have seen, pretermit all such changes in the method of management hitherto followed, as are not in themselves necessary to the proper working, and would interfere with the enjoyment of the right. But it is always deemed within the necessary scope of a proper management, or of an admissible change or improvement in management, to *effect a complete stocking* of the forest area. Nor is the forest owner bound to undertake active operations to maintain or improve the soil production required for the right (we are now speaking of soil rights as distinct from those affecting the tree growth). No duty of maintenance, *in this sense*, exists, even though the right be one created by contract or the forest owner had a concurrent right of enjoyment along with the right-holder. The right-holder can only claim to practice and enjoy his right, while the owner passively submits to it, and carries on his proper forest management without undue interference therewith.

But there are rights which affect, not directly the soil of the forest, but the tree growth, and here the owner's duty of maintenance presents a different aspect. The principal rights of this class are rights to wood (firewood, building wood, &c.), to resin, to fruits, (as beech-mast, acorns, &c.), or to *humus* and dead leaves (*streu*). If the growing stock were not maintained, there could be actually no exercise of such rights, at all. Maintenance of the forest on the part of the owner is here, a naturally as well as a juristically, essential concomitant of the right. Without a permanent growing stock the *perpetua causa* of the servitude would be wanting.

The maintenance of the forest is then, in all cases, the owner's duty; no matter whether the right is acquired by prescription or by grant, or whether the owner makes use of his concurrent right of enjoyment or not.

This duty consists in abstaining from acts which would nullify the right, and prohibits all wasteful working or "forest devastation," *i. e.*, wholesale cutting without provision for reproduction and restoration.*

The fellings must be so arranged as to leave the requisite stock of a kind suited to the right-holder's requirements, as far as this is possible consistently with the principles of management.

* Compare Eding, page 75.

In some European laws, a forest owner who should neglect his duty in this respect, and should thus cause a right-holder to be deprived of his supply of wood, &c., would be bound to compensate him.

But the preservation of an available stock of material, does not extend to any obligation to keep standing over-mature trees, or decayed stems, or those which would spoil if left standing; not even when such material is the subject of a right (*e. g.*, right to fallen wood, &c.)

In the Prussian and Austrian law, a right-holder may claim to have the yield of the forest properly regulated by a working scheme,—which includes of course measures for ascertaining and fixing the proper possible yield of the forest, and dividing the area into proper groups for successional cutting.

Lastly, an indispensable part of the duty of forest maintenance is provision for the due reproduction and restoration of the forest.*

This is recognized *both* by the laws and by the decision of the Courts. A continuous neglect of proper measures of reproduction would ultimately bring about a wood-famine, and would thus put an end to rights of user altogether.

NOTES ON FOREST ADMINISTRATION IN SEVERAL EUROPEAN COUNTRIES.

SOME time ago, I begged Mr. Brandis to ascertain for me to what department of the ministry forest administration pertained in the different countries of Europe, and where and to what extent instruction in agriculture was combined with the teaching of forest science. Mr. Brandis has been good enough to draw up a note on the subject, which I think will be useful to record in the pages of the *Indian Forester*.

B. R.

FRANCE.

Forest administration was formerly under the Ministry of Finance. By a decree of the President of the Republic, of 15th December, 1877, it was transferred to the Ministry of Agriculture and Commerce. This department, which is now styled the Ministry of Agriculture, has ever since dealt with the forest business. There are several Schools of Agriculture; at these, lectures on sylviculture are delivered, and at the Nancy Forest School there is a Professor of Agriculture.

AUSTRIA.

The administration of the Austrian State forests is under the Ministry of Agriculture. The school for those who desire to enter the State Forest Service is combined with the Agricultural College under the designation: *Kaiserliche Hochschule für Boden cultur in Wien.* This institution has a very strong staff of Professors, among whom are four Professors of Forestry.

Besides this, there are four provincial institutions, two of which are maintained by the State, *viz.*, *Die Technische Hochschule, Gratz for Styria*, a Civil Engineering College with one Professor of Forestry, *Lehranstalt für Forstwirthshaft, Lemberg* for Galicia, attached to the Civil Engineering College, with two Professors of Forestry. The two other forest schools, *Weisswasser in Bohemia* and *Eulenberg*

in Moravia, are private institutions, which are maintained by the large forest proprietors in those provinces.

Prussia.

The administration of State Forests was placed under the Ministry of Finance by Royal Decree of 16th December, 1808, and this arrangement continued until 7th August, 1876, when it was transferred to the Ministry of Agriculture and State Domains. There was a break from 1835 to 1848, during which period the State forests were in charge of the Ministry of the Royal House. Under the existing organisation the Oberland forstmeister is in charge of the Forest Branch in the Ministry of Agriculture and State Domains.

The two Prussian Forest Schools of Neustadt Eberswalde and Münden are exclusively intended for forest students. Sylviculture is taught at Poppelsdorf and at the other schools of Agriculture.

Bavaria.

The State forest administration is under the Ministry of Finance. There is a Forest School at Aschaffenburg, and another attached to the University of Munich.

Saxony.

The Ministry of Finance has charge of the State forests. The Forest School at Tharand was formerly united with a School of Agriculture. A few years ago it was decided to attach this institution to the University of Leipzig. There was at the time a talk of moving the forest school also to Leipzig, but it was found more convenient to leave it at Tharand for the present.

Wurtemberg.

The State forests are under the Ministry of Finance. The forest school was formerly at Hohenheim, where it was combined with the school for Agriculture. In 1881 the forest school was attached to the University of Tübingen, while the school for Agriculture continues at Hohenheim.

Bonn:
19th June, 1885.

D. Brandis.

THE MOREL.

It may interest the readers of the *Indian Forester* who are fortunate enough to possess fine palates, to know that the morel (*Morchella esculenta*), an edible fungus which rivals the truffle in delicacy of flavor, is common in Jaunsar, and was found by me in abundance in May last in that portion of the *Dedra* Gád deodar forest belonging to the Keuntul State, which suffered so severely from fire last year. The paharis set great value on it, and eagerly gather all they can find.

The following is the account of this fungus in the *Treasury of Botany*, where a good illustration of the plant is given :—

"Morel is the common name of *Morchella esculenta*, which under a variety of forms, occurs in various parts of the world. It is occasionally plentiful in this country, but the greater part of what is sold by the oilmen comes from Germany. A large quantity is collected in Kashmir. As it dries very readily, and may be kept for some time, it is much used by cooks to flavor gravies. It is also dressed in various ways when fresh, and makes an excellent dish if stuffed with finely minced white meat. When plentiful it may be advantageously employed instead of mushrooms to make ketchup. Morels are particularly fond of burnt soil, and the collection of them is so profitable to the peasants in Germany, that they were formerly in the habit of setting fire to the woods to encourage their growth, till the practice was made punishable by a special law. *M. semilibera* may be known from the common morel by the border being quite free for some distance. It has a bad reputation, and requires, therefore, some caution in its use. The genus *Morchella* is distinguished by a deeply pitted naked head supported on a peduncle. The depressions are sometimes regular, but occasionally they assume the appearance of mere furrows with wrinkles like interstices."

N. HEARLE.

NOTE ON DEODAR FLOWERS AND CONES.

I WATCHED a tree just in front of my house, which I have observed to be a male, that is, it has never borne cones (during the past four years). On the 20th June there was not a sign of catkins, even with a glass, but on 26th June I found them for the first time; so small that the scales were not visible. This may be taken as about the earliest appearance of the male flowers of deodar.

Regarding the cones—they are now 4 inches long and 2½ inches diameter. Can there any longer be doubt that these will ripen in October? If they do, then it is proved that from the first appearance of the cones (20th August, 1884) to the ripening in October 1885, a period of 14 months elapses, and not two years. It has also been observed this year that trees which bore seed in 1884 (last year), have again cones, which should ripen in October next; these trees were specially marked, and seedlings are alive and carefully protected, under them.

KALATOP,
9th August, 1885.

J. C. McD.

NOTE.—We have received two young deodar cones from our contributor, each about ¾ inch long, which he picked on the 20th August at an altitude of 6,500 feet.

III. Official Paper.

NOTE ON STRIP FELLINGS FOR SAL COPPICE.

Introduction.—The principal reason for the adoption of the system described in this note, and called by me the "strip system" (from the forests being felled in strips in regular order), is the gradual conversion of sál coppice forests in the plains from a state of ill-conditional pollard or crooked coppice growth, into well grown, straight coppice growth; this is done by cutting over the felled trees flush with the ground, by which, as a rule, strong straight shoots come up from the ground level, and, if properly protected from fires and cattle, the newer growth will give useful material for native buildings and agricultural purposes; the inferior growth, as well as the tops and branches of the felled trees, will supply fuel; whereas under present circumstances the produce is stunted in its growth, and the greater part is unfitted for building and agricultural purposes. The two forests in which I have adopted the system are the Akona forests of the Kapurthala State in Bahraich, and the Pilibhit reserved forests. In the former the bulk of the forests consists of stems which have been cut over about 4 feet from the ground, and when any straight shoot appeared it was cut off; this system having been continued for many years, the stock on the ground is principally composed of gnarled and crooked stems which give but few straight shoots; the diameter of the stems as a rule varies from 4 to 9 inches at one foot from the ground. In Pilibhit the trees were originally cut over badly, and with the combined influences of bad treatment,* fires, frost, and climbers, are principally crooked young shoots (on old roots) which at present are only useful as fuel: it is hoped that much of the re-growth under more favourable circumstances will be of much more value, and yield building material.

As far as I know, felling in narrow strips or belts is only occasionally practised in a few places on the Continent of Europe, and this is for the purpose of obtaining reproduction from seed in "high forests" situated on mountain sides; here narrow strips are cut in a direction at right-angles to the

* It is possible that some of the crookedness of the stems may be attributed to later felled trees falling and damaging young coppice shoots—*see* paragraph 21 (*j*).

direction of the prevailing wind, so as not to let the wind get into the forests and work destruction among the weak, tall, drawn-up stems, which it would if large spaces were felled at once.

I know of no *coppice* forests having been worked on the "strip system" till I experimented in Bhira and Akona.

In Oudh, in making 100 and 50 feet clearings in the past 16 years in "high forests," for block and compartment division lines, I noticed that the growth of seedlings and saplings in the cleared belts, on good and average soil, was much superior to that in the high forests on both sides of the clearings, light being admitted; at the same time for some part of the day, though there is no deleterious "cover," there is partial shade on the clearings, and at the same time the growth on the clearings gets the benefit of the aërial moisture from the adjacent high forest. In poor soil, and where there is much grazing, the reproduction from seed has been poor, and the stools of even young trees have not coppiced, as in these broad strips too much sunshine has been admitted; the bad condition of the soil is also shown by there being no long grass.

In Oudh experience has shown that in coppice forest it is not safe to cut over large areas at once, coppice so treated has done well in places where the growth was strong and the soil rich and damp, but in other places the frost has got in and the regrowth has been cut over every year by it, and it has not recovered itself in eight years or more.

In 1877 I made in the coppice forests of Bhira the experiment recorded in Appendix "A," Oudh Forest Report for 1876-77, Mr. Wilmot conducting the operations. I cut over five acres in one plot, three acres by two acres long, one acre being untouched. (1), two acres (about 210′ × 420′) flush with the ground, cutting over everything; (2), two acres (about 210′ × 420′) flush with the ground, in strips of 20 feet broad, leaving 20 feet of forest standing; (3), in one acre (210′ × 210′) I cut out flush with the ground about half the standing stock, leaving the best poles. In No. 1 the growth came up with promise at first, but the first year of strong frost cut back the shoots, and it has never recovered from frost; it is true that part of the plot was on poor soil, that there is much grass, and that a fire once got in: in No. 2 the shoots have come up straight from the ground, often one good leading shoot, the forest on both sides has drawn them up and protected them from the frost: in No. 3 the growth has not been so good, as the shoots cannot rise so straight owing to overshadowing trees: fires got into these plots as well as in No. 1, but the damage was much less.

Mr. Amery about 1874-75 cut over a large area of sál coppice in the Rámgarh forests, Gorakhpur, over 100 acres in one place; the plot had sál coppice on three sides, and a broad drainage line on the other, beyond which was lofty sál forest.

This area has suffered very much from frost, and part of it was planted up with sissú, which, owing to the high grass which sprung up, did not do well.

On the other hand, I have seen a large area further north in Gorakhpur, where the soil was better, where Mr. Amery made a large clearing about the same time as in Rámgarh: here the trees have come up and do not seem to have been much damaged by frost; but they, as a rule, have a number of shoots from the same stool and are bushy. I have seen other places in Oudh and Gorakhpur where large clear fellings have been made without apparently much damage from frost, but it may have been that the soil in the part cut was rich.* In the Rámgarh block the coppice forest has been extensively thinned all round the clear felling, but frost has not got at the undergrowth, showing that a certain amount of standing stock protects the young undergrowth.

It is a practise among Indian cultivators to sow lines of *arhar* with their cotton, the latter suffering much from the frost; the *arhar*, which is one of the only plants besides castor that stands the same time on the ground as cotton, and which, though it suffers from *extreme* frost itself, has a *protecting* influence on the shorter and weaker cotton stems under ordinary circumstances.

It seems paradoxical at first that in India the frost should do so much damage to young indigenous undergrowth, whereas it does not in colder countries, where large areas of forest are coppiced at one time; but in the colder countries the plant is suited to the climate; the great cry of European foresters is "that harm is done in uncovering the soil" in what to us Indian foresters is a mild, damp climate; the plants dry up (particularly seedlings), most European forest trees being surface-root feeders, whereas Indian forest trees are for the most part deep-root feeders, and once they have got their roots well down, the hotter the weather the better they grow if the sub-soil be damp as it usually is; they, too, are suited to the climate they have to live in. In a state of nature the seedlings of gregarious forest trees, as sál, would have some protection from the parent trees till they could exist independently; and in the same way where young stems are damaged, the re-growth would have the protection of the surrounding trees.

* This is shown particularly in the south Balapur Forest of Akona which was cut over for cultivation much lower than usual, and is now a fine grown straight coppice forest, but here the soil is good, wheat still growing on the land reclaimed from the forest over 12 years ago; in other parts of Akona land that had been reclaimed from the sál forest has lapsed into jungle. As a rule sál forests are on poor sandy soil; if the soil had been fitted for agriculture, the chances are there would have been less sál forest than there is. When I speak of the *dampness* and *richness* of the soil in forests, it must be remembered that these two states are partly caused by the growth itself, and that if the trees were cut away, and the ground ploughed up, the dampness at once would disappear, and the richness be extracted by a few years of agricultural cropping.

It may be asked how is it that the present sál coppice forests exist? The reply is, that the people who have had the cutting out of stems have only felled out here and there, taking the stems they required, leaving many that were not fit for their wants, and thus securing a certain amount of protection. In Akona, for instance, there are plenty of pollarded stems on the ground, but the treatment they have received is such that only a few straight poles for building can be got out of the forests; whereas if the forests had been cut on a regular plan, there would have been plenty of stems, not only for the people in the immediate vicinity, but for a large population all round the forests. But we can trace on the ground where sál coppices once were, which, being overworked, have degenerated into unfertile waste lands, with only a few hardy thorns on them.

In the past two or three years I have made some small experiments in strip felling in a small plot near Mahofe (Pilibhít); here, though the young growth in the open is killed by the frost, the undergrowth, where sheltered by forest on both sides, was untouched by frost.

In the past three springs I have made experiments in strip felling in Akona, where the forest is for the most part pollarded sál from 25 to 30 feet high, I cut in strips $8\frac{1}{4}$, $16\frac{1}{2}$, $49\frac{1}{2}$ and 66 feet broad. I am inclined to think that $16\frac{1}{2}$ feet strips are best suited for the height of the forest, the soil, and the growth: $8\frac{1}{4}$ feet did not give enough light, except in very thin and low forests, any small advantages gained are, I think, counterbalanced by the difficulty of working such narrow strips and by the expense; $16\frac{1}{2}$ feet gave enough light, the stems were well drawn up and straight, and the grass there, not having too much light, was not excessive in its growth, whereas it was in the broader strips (it would do much damage to the re-growth if fired); and the re-growth in the broader strips did not seem to me so straight or well grown. In October last I visited the strip fellings and found that the dominant coppice shoots (which would form the principal growth of the future) on an average showed 7 feet high for the first year's growth, 12 feet high for the second year's growth, and 16 feet high for the third year's growth; giving respectively 7, 5, and 4 feet a year.

From the first I noticed that the top of every coppice shoot was cut off by some sort of flying beetle or grasshopper which must have done its work in the rains; but I am glad to say that the damage is not lasting, a side shoot taking the place (as a rule) of the killed shoot, though in many cases there was a bifurcation. On the whole, however, the damage is not much. Besides the coppice shoots in the strips, I examined every coppice shoot I came across in the forests, not in the strips, and found the same thing; so that it is evident that almost every coppice shoot is eaten over yearly, and that the trees generally recover their straightness with the next year's growth, though

many bifurcate; but I have the consolation in believing that all our straight coppice growth in Bhira, Bahraich, Gonda, and Gorakhpur has undergone the same treatment.

The insect eats the bark almost all round the shoot about 6 inches from the top, so the shoot either dies and drops off, or is weakened, so that one or more of the shoots in the axils of the leaves below the damaged part takes its place; but there is generally no permanent injury done to the interior of the stem; there are generally small bulges where the new shoots originated, which, as the trees grow older, gradually disappear. The damage of bifurcation, however, might be remedied, if it were found worth doing so, by cutting away one of the contending shoots after a year or two. The tops of the rapidly-grown coppice shoots (many making as much as 10 and 12 feet growth from the ground in the first eight months after the original stem was cut over) are extremely succulent, and thus attractive to the insects; whereas seedlings, which are not so attacked, are slower growing (having only young roots), and are consequently not so juicy. I expect the crookedness of the coppice in some forests is more due to the attacks of insects and frost than to the hot winds to which Dr. Brandis was inclined to attribute the injury in the coppice forests of Nawábganj (Gonda Division).

I give in the accompanying diagram, (*Fig.* 1, *Plate* I.) a representation of a theoretical felling in strips. I have adopted the width of the periodic* strip at $16\frac{1}{2}$ feet, as I think it best for coppice forests of the height we shall most probably have to treat sál coppice in the first rotation at least, say from 25 to 33 feet; this width is also convenient to work with, as a mile of periodic strip covers two acres, every furlong one-fourth of an acre. I have also taken four periodic strips, *i.e.*, $16\frac{1}{2}' \times 4 = 66'$, as my complete strip and basis for working. "Four" is the first number in which after cutting the primary strip I get a *central* strip that I can cut out in the second period; five gives unequal spaces after the first strip; six leaves five, giving a central strip with two on each side, but the area to be worked over is greater. With a fourfold strip in a 24 years' rotation I work over one-sixth of the forest: with a sixfold strip I have to work over one-fourth of the forest, (*Figs.* 1, 2, 3, *Plate* II.) Thus in a forest I cut out the primary periodic strips AA (*Fig.* 4) in the first period, they have full grown forest CC and DD on both sides, till CC and DD are cut over in the third and fourth periods respectively. BB being cut in the second period, have

* By "period" is meant the number of years that it takes to get round the number of compartments into which the forest is theoretically divided, with one periodic strip; (in the same way "rotation" means the number of years it takes to work the four periodic strips, *i.e.*, the whole forest): thus if there were four theoretical compartments, the "period" would be one of four years, and the "rotation" 16. The periodic strips are primary "A," secondary "B," tertiary "C," and fourth in order "D."

the full height of the forest on both sides till the beginning of the third period, when strips CC are cut, and till the beginning of the fourth period, when strips DD are cut. CC fare worst of all: when they are cut the growth AA is of two periods, and that of BB only one; whereas DD when cut have on one side AA with a growth of three periods, and BB with a growth of two periods.

Thus, according as the rotation is to be 16, 20, 24, 28, or 32 years, I would divide the forest in which I am working (that is, one "working circle") into 4, 5, 6, 7, or 8 compartments of about equal size and yield.*

For simplicity's sake in the diagram I have taken a rotation of 16 years, in which the fellings would be as below:—

Year of felling.	Location of felling.		
1	Compartment I.,	Strip A,	Primary periodic strip.
2	" II.,	" A,	" " "
3	" III.,	" A,	" " "
4	" IV.,	" A,	" " "
5	" I.,	" B,	Secondary " "
6	" II.,	" B,	" " "
7	" III.,	" B,	" " "
8	" IV.,	" B,	" " "
9	" I.,	" C,	Tertiary " "
10	" II.,	" C,	" " "
11	" III.,	" C,	" " "
12	" IV.,	" C,	" " "
13	" I.,	" D,	Fourth " "
14	" II.,	" D,	" " "
15	" III.,	" D,	" " "
16	" IV.,	" D,	" " "

The rotation is equal to the number of periodic strips four in number (a number which remains always constant), multiplied by the number of compartments (which varies).

At the end of the rotation the age of the growth in the various strips would be as below, and the strips could be again worked in the same rotation if it were necessary to do so:—

Compartment I.,	Strip A,	16 years.
" II.,	" A,	15 "
" III.,	" A,	14 "
" IV.,	" A,	13 "
" I.,	" B,	12 "

* As shown hereafter, the rotation can in practise be made for any number of years, and not merely for multiples of four.

Compartment	II.,	Strip	B,	11	years.
"	III.,	"	B,	10	"
"	IV.,	"	B,	9	"
"	I.,	"	C,	8	"
"	II.,	"	C,	7	"
"	III.,	"	C,	6	"
"	IV.,	"	C,	5	"
"	I.,	"	D,	4	"
"	II.,	"	D,	3	"
"	III.,	"	D,	2	"
"	IV.,	"	D,	1	year.

As I have shown the danger of felling in large areas at one time, it may be asked—why not divide the working circle into, say, four compartments (or more according to length of the rotation), thinning out one-fourth of the stock of compartment I. in the 1st year, one-fourth of compartment II. in the 2nd year, one-fourth of compartment III. in the 3rd year, one-fourth of compartment IV. in the 4th year, then returning to compartment I. in the 5th, 9th, and 13th years, compartment II. in the 6th, 10th, and 14th years, compartment III. in the 7th, 11th, and 15th years, compartment IV. in the 8th, 12th, and 16th years? The advantages of the strip system of felling over the system of periodic thinnings I will endeavour to give in paragraph 21.

There remains, therefore, I think, only another system of cutting over, *viz.*, in small plots, say squares; but this aggravates the one disadvantage of the strip system, as it would require very much more time and expense in marking these plots on the ground, and there is the other great disadvantage that the produce would have to be removed either through growing forest or through new growth, and the work would be extremely difficult to supervise.

The advantages of the strip system over periodic thinnings will, I think, be those given below:—

(*a*). The strips being marked on the ground, or rather the centre of the primary strip, everything is (as a rule) cut over flush with the ground, the outturn is more regular, and nothing is left for the workmen to do but to fell and cut up the produce; in the thinning system the chief man would have to mark one tree in four in the first thinning, one in three in the second, one in two in the third, leaving everything in the fourth to be cut over, or leave the work to the discretion of the workmen; but there would always be the danger of the chief man's marking re-growth of former thinnings for the final thinnings, he might even mark for felling in the second and third periods re-growth of the first period. In the strip system the work after it

is laid out is merely mechanical; in the thinning much observation is necessary. In the strip system good and bad (or rather bad and very bad) are cut together; in the thinning system opportunity is given to the marker of the trees to favour intending purchasers, leaving worse stuff for the future, which it might be difficult to dispose of.

(*b*). In the strip system everything (or nearly everything) is felled over on the strips, and in removing the cut produce no damage need be done to the new growth of coppice, as the strips are cut flush with the ground, and the shoots do not appear above ground till after all the cut produce should have been removed; and, again, the produce once removed there is no traffic over the strip for the whole of the existing rotation; in the thinning system removing the cut produce four times* in each compartment must always do much harm to the growing stock, particularly in the last thinnings, when the ground is covered with tender coppice shoots, the result of previous thinnings.

(*c*). In the strip system, even if the rotation cannot be worked up to on account of a bad market, as the periodic strips follow regularly in the numbered compartments, there would be no irregularity in the succession of the fellings though the rotation might be longer; in the thinning system it would be much more difficult to know where the work left off, so as to take it up properly the following year or period.

(*d*). In the strip system the work being open to the directing and traffic lines can be much better examined and controlled than in the thinning system, which takes place among tree growth and at considerable distances from roads.

(*e*). In the strip system the shoots, having no cover overhead, will, as a rule, form straighter stems than in the thinning system, where the shoots will have to grow under partial cover; in the latter they will grow towards the light, wherever it may be.

(*f*). In the strip system, the work being easier controlled, the stumps will be cut better than in the thinning system. In the strip system the controlling officer has merely to inspect the area felled over; in the thinning system he would have to go over four

* If we remove the produce in less than four times, we should be probably thinning too much, and the strip system would have the advantage of a more gradual thinning.

times as much ground, with growth far more difficult to inspect. Felling by contract will be much more easy to control in the strip than in the thinning system.

(*g*). Should it be desired to leave any number of standards per acre for seed or for larger timber, in the strip system this can be well left till the third or fourth strip periods; thus if it be desired to leave 50 standards per acre, in the strip system one has merely to make a simple calculation. The complete strip of 66 feet, 660 feet long, contains 1 acre, 25 trees in the third and fourth periodic strips have to be left standing on one furlong of 660 feet, that is, the trees to be left would be about $\frac{660'}{25} = \frac{132'}{5} = 26\frac{2}{5}$ feet apart. In the four thinnings it would be much more difficult to select and mark the trees that were to remain as standards; their distance apart could not without much labour and expense be so well regulated as in the strip system.

(*h*). In the strip system there is a better chance of seedlings springing up, as though they have shade they have no cover, and thus get the dew, and they run no risk of being trampled over as any seedlings that may come up do in the thinning system, on the removal of produce in the succeeding thinnings.

(*i*). In the strip system, the area worked over may any moment be ascertained; whereas it is extremely difficult, without fresh measuring, to ascertain the exact area that has been thinned.

(*j*). In the strip system, everything being felled over a certain space, the falling trees can fall upon the trees already on the ground, and thus do no damage to standing stock; whereas in the thinning system in the last three thinnings the trees felled must necessarily fall upon the young growth, to its probable damage and possible destruction.

There is one disadvantage that I have found in the strip system, and that is the expense in laying out the work in the first period; great care has to be taken in such narrow strips that they are exactly parallel to each other, otherwise the following periodic strips will run together; but when the work is once systematised this disadvantage will, I hope, disappear; a careful man on Rs. 5 or Rs. 6 a month with a good eye can easily run a straight line if one or two directing poles are laid down for him from the directing line, to which the strips should run at right angles. If secondary light lines (guide lines) about a furlong or

more apart, and parallel to the directing line, be laid down beforehand, and pegs placed on them 66 feet apart, no error would be allowed to accumulate. When the first periodic strip has been felled the felling out of the middle strip in the second period comes easy, and in the third and fourth periods it only remains to cut out the strips left standing which can easily be distinguished from the new growth of the first and second periodic strips.

In practice we may do away with the theoretical equal compartments,* taking care, however, to work the primary strip in a systematic manner, that it will not be difficult to follow the same order in the second, third, and fourth periods. If the demand is equal to or more than the supply, the working plan can be exactly worked up to; but if the demand is less than the supply, or not constant, as long as the proper order is followed in all four periods, there will practically be no harm done; the rotation will be longer (a fault generally on the right side), or we can make up for our scant fellings of one or more years by heavier fellings when there is a demand. Thus, suppose in a working circle, with a 16 years' rotation, we have an area of 10 square miles = 6,400 acres, the area to be cut over annually is $\frac{6400}{16} = 400$ acres; this means 200 miles of strip: now if we can sell only 150 miles of strip this year, we may sell 250 miles the next; or if we take 20 instead of 16 years to complete the rotation, the succession of the fellings is not vitiated; and though we may not have sold so much as we wanted to, we are really no worse off as we have four years stored up capital, and in the future there is no doubt the demand will be more than the supply. One thing we must not do, and that is, cut more than the sum of the annual yield up to date.

Of course cattle must not be admitted, the area must be protected from fire, and people must not be allowed to go whenever they like with carts, loads, elephants, amongst the young growth, or even alone whenever they can tread down young coppice or seedlings: a certain amount should be made into roads and paths to prevent the people from being inconvenienced.

The longer the forest has been fire-protected and cattle excluded, the better will be the chance of the new growth; and in our newly-protected forests it may be found that the growths of the third and fourth periods will in many cases catch up the growths of the first and second periods, as they will have a much richer soil to start growing in.

* In dividing the forest into compartments we must make the division lines in such directions that they may act as traffic or inspection roads, and by making the roads suit the convenience of the villagers, we take away from them any excuse for wandering in the closed forests.

Before commencing operations it is (even for thinnings) necessary, a year or two before, to kill out all the climbers, otherwise the work will be very expensive, as the cut trees are entangled with the standing ones, and cannot be extricated without much labour.

The strips should meet the chief traffic line of the compartment which may or may not be the directing line. Much expense is saved if it is so, and it should be so unless, for special reasons, a particular direction has to be given to the strips. If the traffic and directing line be not one and the same, the directing line should be laid at right angles to the proposed direction of the strips (it need not be more than 2 inches broad).* The 66 feet spaces (*Fig.* 5) should be all pegged out on the edge of the directing line before work is commenced, with stout sál pegs which will last many years, and just before working light lines should be run parallel, according to the density of the forest at one or two or more furlongs distance from the directing line, or the strips may run out to the open country to which the produce may be carted away; these light guide lines being also pegged every 66 feet commencing with a point at right angles to a peg on the directing line; there will be no danger of any error occurring in running the primary strips and the mixing up of the others afterwards: the primary strips will be always guides to the latter workings.

As to the direction of the strips themselves, as a rule I do not think it of much importance for the growth; as a matter of convenience I prefer having the work done north and south, thus the man who lays out the lines can work with a prismatic compass over the needle without having to think of the angles, and in very frosty places I think the young growth in the cold weather is all the better for being shaded in the early morning from the rays of the sun. This is effected by having standing strips of forest running north and south; a plane table is convenient to mark off the strips with when the directing line is made.

In cutting the strips all damaging cover of trees on either side should be cut away. The tendency in cutting the primary strip has been to make them broader than 16½ feet; this should be seen to, as if it be too much, the third and fourth periodic strips will be too narrow; this difficulty is, however, partially removed practically as the timber on the third and fourth periodic strips, being some years older than that cut over on the first and second periodic strips, will yield more produce to the acre than the strips first cut over.† The reason the primary strips have been cut too wide is that in running the first light line for the primary strips, we have taken the light

* The directing line is the line to which the strips run at right angles.

† But we should sometimes have to leave standards in the third and fourth periodic strips; so the more correctly we work the better.

lines as the edges of the strips; in running these lines small clearings have to be made for the men to work in, and consequently part of the strips DD are cut into. This may be obviated in future in laying out the light lines, by taking the light lines from the pegs as before, but taking the light lines as the centres of the primary strips, instead of the edges as before, and felling $8\frac{1}{4}$ feet on both sides of them; in this manner anything that has been felled either to the right or left of the light lines will properly come within the breadth ($16\frac{1}{2}$ feet) of the primary strips.

The work of cutting should be commenced in November, and all the material should be removed off the strips before the 15th of March, so that no damage be done to young shoots which will come up directly the warm weather commences. The material, if not sold on the spot, should be stacked in the vicinity to dry, and be carefully guarded against fire, the carting of the material to market, particularly if the market be distant, should not be commenced till the fuel be dry, otherwise there will be much loss in carriage.

I will not here go into the subject of taking from the felled stuff the bark which in time I hope will fetch as much as, or more than, the wood itself.

As a rule everything should be cut over flush with the ground in the first and second periodic strips, as it is of importance to get a long, uninterrupted view of the strip; but if any promising straight young stems are left standing on them, they should be trimmed carefully of any side branches up to a height of 6 feet from the ground, so that the view up the strip may be interrupted as little as possible. The standards so left should also be painted with white paint at 5 feet from the ground with a ring one inch broad, so that, in examining the growth afterwards, young standards may not be mistaken for fresh coppice shoots. In the third and fourth periodic strips, the strips being bounded by the originally straight cut strips, there is not the same necessity for the long, uninterrupted view.

I do not advocate the adoption of the strip system for all coppice sál forests; there may be many coppice forests in which a great part of the growing stock consists of straight stems, and where it would be better for the improvement of the forest to content ourselves with cutting out the inferior stems: but even here a modification of the strip system might be adopted, cutting in much broader strips instead of cutting all over the forest, thus concentrating work and doing away with many of the disadvantages which I have shown are inseparable from frequent periodic thinnings all over a forest. In thinnings, when they are done at long intervals of time, little harm is done to the young growth by removing produce; it is where the removals are often that the damage is so great.

Strip fellings may, I believe, be conducted in some of our

high sál forests with advantage, taking out all crooked and unsound trees of all ages when a market can be found for the produce, and this particularly in places where the standing stock is bad, the breadth of the strip will depend upon the height and density of the forest, a broad strip of high forest between the cut over strips would tend to keep them partially shaded for some hours of the day, prevent too rapid evaporation from the ground, and yield moisture to the new growth. The periods would necessarily be of much longer duration than in coppice forests, and all the stock that would improve by keeping till the next felling would be left. In fact Dr. Brandis, in his suggestions of 1881,* when treating of the Motipur forests of Bahraich, pointed out the possibility of such a system being some day pursued. The late Inspector-General had just seen in his inspection the splendid young growth on the Nipál boundary line, which, together with experience gained in other forests, led me to make my experiments in Bhira in 1876-77.

I have stated the disadvantage of the strip system, *viz.*, the expense of marking out the strips on the ground: this is a known expense, but I am of opinion that in conducting operations that have not only for their immediate object the supply of timber and fuel and the getting rid of bad stuff, but the ultimate object of greatly improving the forest, the expense (provided the work be carried out properly) is a fair charge against forest improvement, and I believe the superiority of the work and the greater economy with which it can be conducted and the advantages obtained will fully compensate for the initial expense.

E. Wood, *Captain,*
Conservator of Forests, N.-W. P. and Oudh, Oudh Circle.

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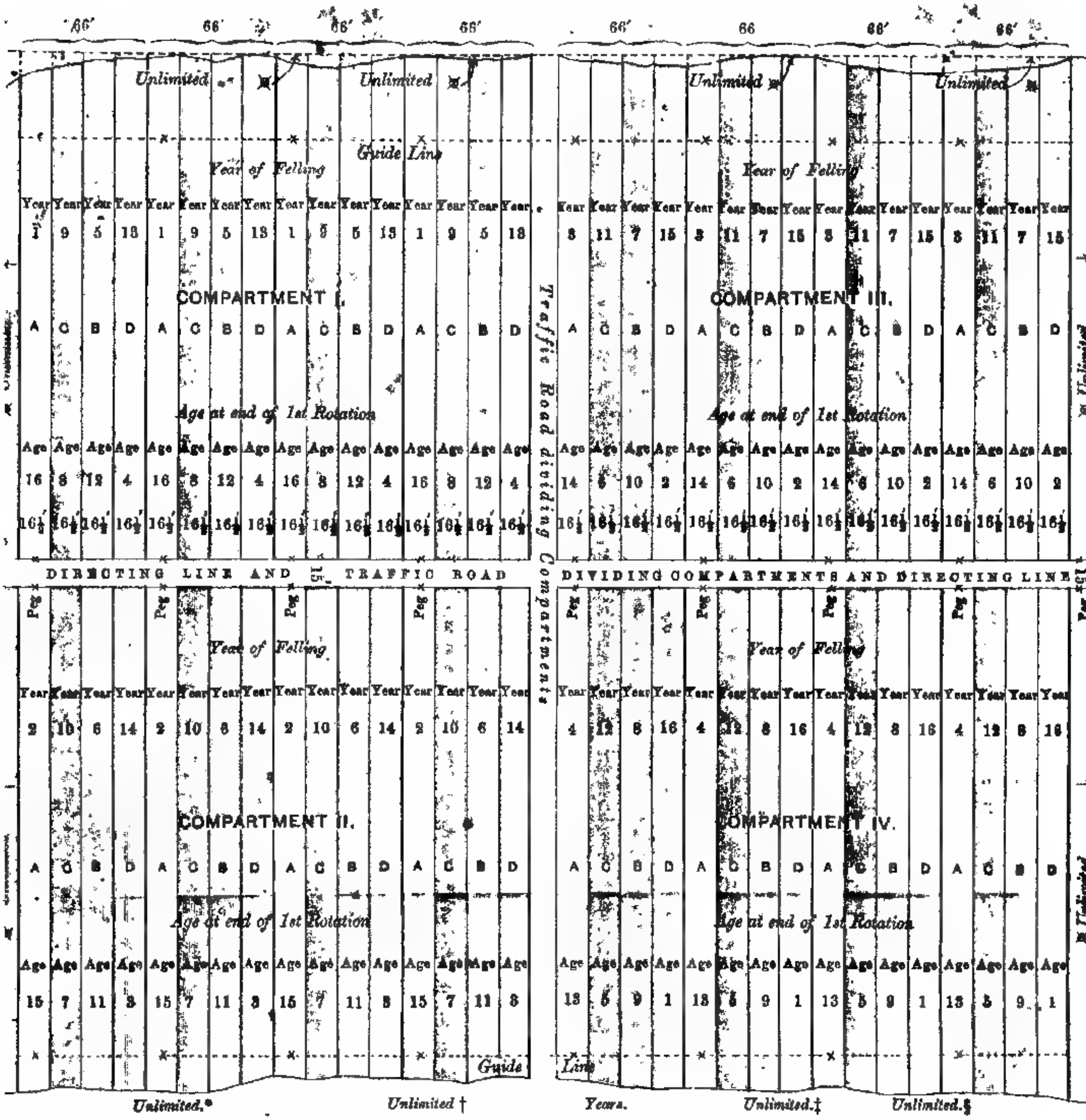
* Page 27. End of first part of paragraph 78.

Fig. 1.

THEORETICAL PLAN OF STRIP FELLINGS.

Four Periodic Strips; Four Compartments: Rotation 16 Years. Forest, Pollard or badly-coppiced Sal, 25′—33′ high.

Scale—66 Feet to an Inch.



* Except by forest boundary.
† Pegs.

A. Yellow, strips felled over in 1, 2, 3, and 4 ... 1st period of 4 years,... Primary.
B. Green, „ in 5, 6, 7, and 8 ... 2nd „ „ ... Secondary.
C. Red, „ in 9, 10, 11, and 12 ... 3rd „ „ ... Tertiary.
D. Blue, „ in 13, 14, 15, and 16 ... 4th „ „ ... Fourth in order.

NOTE ON STRIP FELLINGS FOR SAL COPPICE.

Fig. 1.

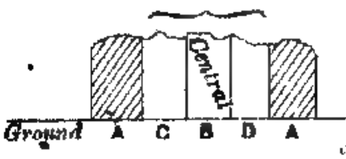
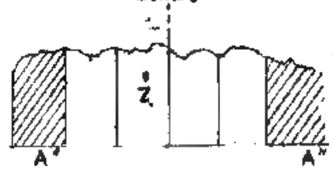


Fig. 2.



If I cut out Z I should have one strip to A' and one to A".

Fig. 3.

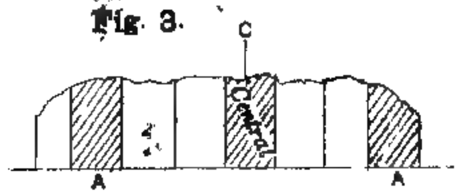
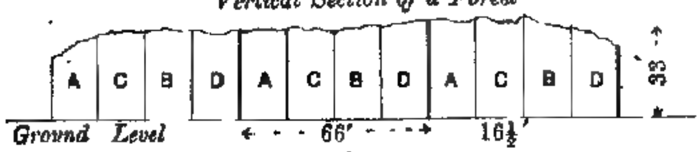


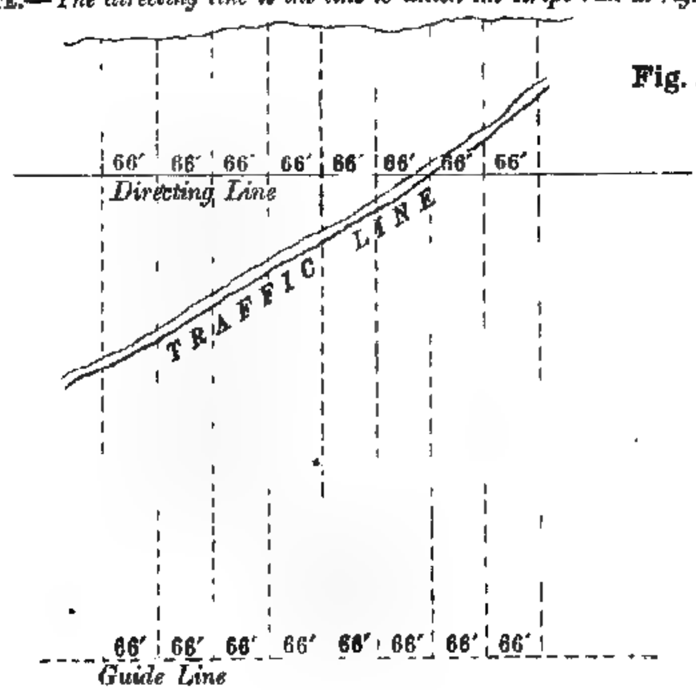
Fig. 4.

Vertical Section of a Forest



NOTE.—*The directing line is the line to which the strips run at right angles.*

Fig. 5.



THOS. D. BONA, Supdt. Litho. T. C. Press, Roorkee.

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REMARKS ON THE ADMINISTRATIVE FOREST STAFF OF PRUSSIA AND THE TRAINING OF ITS OFFICERS.

MAJOR Bailey lately suggested to me that I should put together, for the readers of the *Indian Forester*, a few remarks regarding the training of candidates for the administrative forest service in Prussia and other German States. I have endeavoured to do so in the following pages, and hope that the data, which I have collected, may interest some of those with whom I have had the pleasure of being associated during my Indian service.

The total area of the State forests in the kingdom of Prussia is 2,670,228 hectares (6,597,000 acres), and the ordinary annual yield of this area in timber and small wood, amounts to 7,608,617 cubic metres (5,374,000 loads of 50 cubic feet). The financial results, as estimated for 1884-85, in pounds sterling, stand as follows :—

	£	£
Receipts, ...		2,616,600
Current ordinary charges, ...	1,530,000	
Capital outlay and extraordinary charges, ...	122,000	1,652,000
Surplus, ...		964,600

Thus the gross revenue from one hectare amounts to 19·6, and the net revenue to 7·2 shillings. The area here stated is total area as it stood on 1st April, 1884, and includes 112,340 hectares of roads, lakes and ground which cannot be utilized.

The money return of the Prussian State forests is smaller

than in some other States of Europe. Thus, for the State forests of France, not including Algeria, the *Annuaire des Eaux et Forêts* for 1885 furnishes the following data :—

Total area (December 1884),		hectares	1,012,688
Gross revenue,	...	... £	1,403,400
Charges, ...	...	... „	579,040
	Surplus,	... „	824,360

In the State forests of France, therefore, the gross revenue amounts to 27·7, and the net revenue to 16 shillings per hectare. The chief reason for the difference is the more favorable climate of France, which makes it possible mainly to rely upon natural reproduction, the soil which, as a rule, is more varied and more productive, and lastly, the fact that France has few deposits of coal, and that while in Prussia 25 per cent. of the total area is covered with forest, France has only about 16* per cent.

The subordinate staff of the Prussian State forests, which is chiefly employed for their protection, and which corresponds to Foresters and Forest Guards in India, numbers 3,783 persons.

The administrative staff is constituted as follows :—

I.	Direction (at Berlin): 1 Oberland forstmeister, 3 Land forstmeister, 1 Ober forstmeister, 2 Forstmeister, 1 Oberförster, ...	8	officers.
II.	Inspection: 30 Ober forstmeister and 92 Forstmeister, ...	122	„
III.	Executive: 677 Oberförster, in charge of forest districts or ranges, ...	677	„
	Total, ...	807	„

If we compare this organization with that existing in India, it may be said, that while the Oberland forstmeister corresponds to the Inspector General of Forests, the class of Oberförstor corresponds to Forest Rangers and executive officers of superior rank, say Sub-Assistant Conservators and junior Assistant Conservators. The duties of Conservators and Divisional officers are performed in Prussia by the officers of the class of Ober forstmeister and Forstmeister.

Besides the management of the State forests, this staff has also the general control of more than three million acres of other public forests, *viz.* :—

* Total area of France in 1872—52,905,000 hectares, and area of forests (*Bois et Forêts*)—8,397,181 hectares, according to page 61 of the *Annuaire* for 1885.

977,084	hectares,	belonging	to towns and villages.
88,445	"	"	to public institutions, such as schools and hospitals.
237,005	"	"	to public associations (*Genossenschaften*).
1,302,534	"		or 3,220,000 acres.*

The total area of private forests in the kingdom of Prussia is estimated at 4,473,933 hectares, or nearly 11 million acres. Save in exceptional cases, which are regulated by law, in which the public welfare demands interference, the management of the private forests is entirely free and unfettered.

Training of Administrative Forest Officers.

About 28 permanent vacancies a year arise in the Administrative Forest Staff, which as shown above, comprises 807 appointments. It may interest Indian Forest officers to learn, in what manner these vacancies are filled up. The course of practical and theoretical instruction to be gone through by candidates for the superior forest service in Prussia, as well as the examinations which they have to pass, has lately formed the subject of Government orders, which were published on the 1st August, 1884. The first step is to obtain permission to go through a practical apprenticeship of one year in one of the State forest districts. The papers which the candidate has to submit, in order to obtain this permission, include a medical certificate and the certificate of having passed the closing examination at one of the large German public schools (Gymnasium), which must be passed by all who desire to enter the higher branches of the State service in any of the great public departments.

For those who desire to enter the State Forest Service, a special condition is attached, that they must have passed with credit in mathematics. During the practical apprenticeship the candidate is expected to make himself familiar with the forest district and the working of it. He is employed in timber works, in planting and sowing and other cultural operations, he assists the executive and protective officers in their work, out-of-doors as well as in the office, he is taught the use of instruments, and takes part in surveying, levelling and road-making whenever an opportunity offers. There is much hunting and shooting, and the result is that he becomes well acquainted with the forest district in which he has passed his apprenticeship.

* These, as most other figures of the present paper, are taken from *Judeich und Behm, Forst und Jagd Kalender*, 1885. Some are taken from the work: *Die Forstlichen Verhältnisse Preussens*, first edition (1867), by Otto von Hagen, second edition (1883) by K. Donner, the present head of the Prussian Forest Service (Oberland forstmeister).

In the case of satisfactory progress, the officer in charge of the district (Oberförster) grants a certificate, which is countersigned by the inspecting officer (Forstmeister). After obtaining this certificate, the candidate has to attend during two years the regular course of lectures and practical exercises at one of the German Forest Schools.

Forest Schools in Germany.

In the German Empire there are at present eight superior Forest Schools :—

1. Prussia, Neustadt Eberswalde, Director, Ober forstmeister Danckelmann, Doctor of Law.
2. Prussia, Münden, Director, Ober forstmeister Dr. Borggreve.
3. Bavaria, Aschaffenburg, Director, Forstmeister Fürth, and the Forest College of the Münich University.
4. Saxony, Tharand, Director, Geheimer Oberforstrath Dr. Judeich.
5. Würtemburg, Tübingen, forming part of the University.
6. Baden, Karlsruhe, forming part of the Civil Engineering College.
7. Hesse Darmstadt, Giessen, forming part of the University.
8. Grand Duchy of Saxony, Eisenach, Director, Oberland forstmeister Dr. Grebe.

Of these Forest Schools Tharand is the oldest, having been founded in 1811 as a private institution by H. Cotta. It was taken over by the State in 1816. At present the course extends over two years-and-a-half. The Director, Geheimer Oberforstrath Dr. Judeich, lectures on history and literature of forestry, utilization of forest produce, principles and drawing up of working plans, and control of forests, not the property of the State. The forest district of Tharand (1,020 hectares) is attached to the School, and is, as regards technical matters, under the Director's control. The officer in charge, Professor Neumeister, teaches sylviculture, protection, administration, the art of shooting and hunting. He as well as the Director conduct excursions and practical exercises. There is one Professor for applied mathematics, surveying, levelling and road-making, another for pure mathematics, mechanics and physics. Jurisprudence is taught by the Judge of Tharand ; there is one Professor for political economy and the theory of agriculture, and there are four Professors for mineralogy and geology, chemistry, botany and zoology.

Eisenach and Neustadt Eberswalde were both founded in 1830. At Eisenach the Director of the Forest School, Oberland forstmeister Dr. Grebe, has charge also of the working plans branch for the forests of the Grand Duchy of Saxe-Weimar, and he has the control in technical matters of the forest districts

in the vicinity of Eisenach, aggregating 8,700 hectares. Dr. Grebe teaches forestry, and there is one Professor for pure and applied mathematics and two for natural sciences.

Of late years the question has been much discussed, whether Forest Schools should not be attached to Universities. At Giessen, in Hesse Darmstadt, this arrangement has existed since 1831, and there are two Professors of Forestry, the other branches being taught by Professors of the University. A similar arrangement exists in Würtemberg. The Forest School, which for a time was combined with the Agricultural College at Hohenheim near Stuttgart, was in 1881 re-transferred to Tübingen, where there are now two Professors of Forestry, Forstrath Dr. von Noerdlinger and Professor Dr. Lorey.

At Karlsruhe (Grand Duchy of Baden) the Forest School is attached to the Civil Engineering College, there being two Professors of Forestry, and the other branches being taught by the other Professors of the College.

In Bavaria, the plan of transferring the Forest School of Aschaffenburg to the University of Münich was formed some years ago, but owing to opposition of the ultramontane party in the Chamber of Deputies, it was only partially carried out. Hence the Forest School at Aschaffenburg has been maintained, and in addition Professors have been appointed at Münich for the different branches of forestry and connected sciences. At the time of his death, Gustav Heyer was at Münich, and some men of great distinction are now teaching forestry at that University. Professor Ebermayer, the author of the well-known work on the climatic influence of forests, teaches chemistry and meteorology, Professor Gayer sylviculture and utilization of forest produce, while Professor R. Hartig teaches botany, including diseases of trees, which has formed the special subject of his researches.

The two Prussian Forest Schools have been maintained as distinct institutions, but both are situated in the vicinity of Universities, Neustadt Eberswalde near Berlin, and Münden near Göttingen, and in the case of Münden several of the Professors at Göttingen teach at the Forest School. Both Eberswalde and Münden are situated in the midst of large and instructive State forests, and several forest districts are attached to each of these institutions for purposes of instruction. For these districts the Director of the Forest School is in the position of inspecting officer, he controls their management in regard to all technical matters, and most of the officers in charge of these districts are employed in teaching at the Forest School. The forest districts attached to Eberswalde are Chorin, Eberswalde, Biesenthal and Freienwalde, aggregating 18,665 hectares, or about 46,500 acres, and Forstmeister Bando of Chorin, Forstmeister Runnebaum of Eberswalde, Oberförster Zeising of Biesenthal and two junior Forest officers (Forst Assessor) teach history

of forest management, statistics, general forest economy (forst-politik), protection of forests, forest technology and utilisation of forest produce, hunting and shooting, forest administration, valuation of forests, surveying, levelling, the use of the instruments and road-making. The Director himself teaches sylviculture, the systems of working plans, and commutation of rights of user. Excursions into the forests attached to the School are conducted by the Director and the Professors. Considerable time is devoted to practical exercises in surveying and levelling.

As regards the auxiliary sciences, there is Professor Remelé for chemistry, mineralogy, geology and classification of soils, Luerssen for botany, Altum for zoology, Müttrich for mathematics, mensuration of solid bodies, physics, mechanics and meteorology, while forest jurisprudence is taught by the Judge of Neustadt, Amtsgerichtsrath Rätzell. Several of these Professors have Assistants for their lectures and the work in the laboratory. Attached to the school are a library, laboratory, a museum of natural history and forest products, an institution for pisciculture, and several forest gardens; botanical, zoological and geological excursions are conducted by the Professors.

Connected with the Forest School is the institution for experimental forestry of Prussia, which is under the direction of Dr. Danckelmann. At 12 stations in the different provinces meteorological observations are made, and sylvicultural experiments are conducted under the control of the Director. Similar institutions, but on a smaller scale, exist in all German States, there is a permanent association, and periodical meetings of the Directors and others interested in these experiments are held, when the questions to be solved are discussed, and a programme of proceedings is from time to time agreed upon.

The Director of the Forest School at Münden is Oberforstmeister Dr. Borggreve, and he has the control in technical matters of Gahrenberg and Cattenbühl, aggregating 7,500 hectares, or about 18,700 acres. The different branches of forestry are taught by the Director, the two officers in charge of the forest districts attached to the school, and the officer in charge of a third forest district in the vicinity who resides at Münden. The subjects are divided as follows:—The Director teaches general forest economy (forst-politik), sylviculture, the systems of working plans, valuation of forests, forest literature, the art of hunting and shooting. Forstmeister Knorr takes utilization of forest produce, protection, forest administration and history of forestry. Oberförster Kalk takes mensuration of timber, sub-division of forests and road-making. Oberförster Dr. Kienitz lectures on the peculiarities of (German) forest trees from a Forester's point of view, and assists the other Professors of Forestry. Excursions are conducted by the Director and these three Forest officers. For the auxiliary sciences the

arrangements are similar to those at Neustadt Eberswalde. Political economy, finance and jurisprudence are taught by two Professors of the Göttingen University.

The two Forest Schools in Prussia, as well as those in the other States of Germany, are maintained at the expense of the State. The fees paid by students are insignificant, and amount to about £8 a-year. Candidates for the Prussian Forest Service may study at any of the German Forest Schools outside Prussia, but they must obtain authority for so doing.

After completing their studies at the Forest School, they attend lectures on jurisprudence and political economy (*Rechts-und staats-wissenschaften*) during two terms at a University. This occupies another year. Allowance must also be made for their year of military service, so that altogether five years are spent before they are permitted to present themselves for the first examination.

Examinations.

Candidates must not present themselves later than six years after the commencement of their apprenticeship. Besides the papers regarding practical apprenticeship, their studies at the Forest School and University, they must submit large scale plans with the field-books of a plot which they have surveyed, measuring at least 100 hectares (247 acres), as well as of a line not less than 2 kilometres (1·24 mile) long which they have levelled. Also a forest map, which they have drawn, of an area at least 500 hectares (1,235 acres) in extent.

The examination, like all others for State service in Prussia and other German States, is a pass, and not a competitive examination. A high standard is fixed, which must be attained. The subjects required are—all branches of forestry, surveying, pure mathematics, statics and mechanics, selected branches of jurisprudence, botany, zoology, mineralogy, physics and chemistry. On passing this examination the candidate receives the designation of "Forst-referendar." If he has not attained the requisite standard, he is permitted to present himself once more, but once only.

The next step is to spend two years in practical work in several forest districts. During this period, which is styled *the Biennium*, the Forst-referendar must serve at least six months, between December and May, in the position of a Forester in charge of a beat or sub-division of the forest district. During this time he must carry on the current work of the beat, as regards protection, the cutting, measurement, classification and sale of timber, as well as regards all cultural operations. During another period of five months, he acts in charge of an entire forest district, under the general control of the Oberförster, who remains responsible, and countersigns all orders issued, as

well as reports and accounts rendered by the Forst-referendar while in this position.

At least four months must be devoted to valuation surveys and other work connected with the preparation of working plans. During this time he is attached to a party of the working plan branch, and is charged with the work of junior officers attached to that party, without however receiving any remuneration.

The remaining period of the Biennium must be spent in instructive forest districts, where the Forst-referendar is expected to use every opportunity to become familiar with the treatment of different descriptions of forest and the system of forest administration as conducted in different provinces and under different circumstances.

After completing the Biennium, the Forst-referendar presents himself for the second examination. In addition to the papers relating to his studies and the first examination, he is bound to submit the diary which he is required to keep during the Biennium.

The chief object of the second examination, which like the first is held partly out-of-doors in the forest, is to test the fitness of the candidate for the management of forests and for forest administration generally. The subjects required include all branches of forestry, but the questions asked have more special reference to the actual requirements of the service, than was the case in the first examination. Special attention is also paid to civil and criminal law and procedure, as well as to political economy.

Prospects of passed Candidates.

Those who have successfully passed the second examination, receive the title of Forst Assessor, and are eligible for appointments in the State Forest Service. As far as practicable, they are employed as Assistants (Hülfsarbeiter) in the working plans branch and in the forest branch of the Local Governments of Provinces, as instructors of the candidates for subordinate forest service who are serving their three years in the battalion of riflemen (Jäger) which is attached to each Army Corps, or otherwise on special duty. While thus employed, they generally receive daily allowances. Government, however, is in no way obliged to find permanent employment for passed candidates, and many, who do not find such employment, obtain appointments in forests belonging to towns and villages, to public corporations or private proprietors. On the 15th October, 1884, there were 147 officers holding the rank of Forst Assessor in Prussia, who had not obtained permanent appointments in the State Forests, and of these 29 had passed their second examination in 1882, 20 in 1881, 24 in 1879, and 9 in 1878.

In addition to these there were 83 military officers, belonging to the Corps of *Reitende Feldjäger*, who had passed the same

examinations, and who are equally eligible for appointments in the administrative staff of the forest service. The Corps of Reitende Feldjäger was established in 1740, with the view of forming a Corps of Guides for the army in the field. Most of its members look for permanent employment in the administrative forest service, and are meanwhile eligible for temporary employment in the same manner as civilian Forst Assessors. Those who desire to enter this Corps, must serve their year with the Riflemen, and must pass a special examination afterwards. Service as Feldjäger has certain advantages, and admission is not readily obtained. In time of war they carry despatches or are otherwise employed, and some members of this Corps are always on duty as Foreign office messengers to carry despatches between Berlin, London, Paris, Constantinople, and other capitals.

Before 1866, when Prussia attained its present extent through the annexation of Hanover, Schleswig-Holstein and other provinces, the annual vacancies on a total of 436 administrative forest officers amounted on an average to 16. In the 31 years, from 1835 to 1865, there occurred 504 vacancies, whereas during the same period the number of those who passed the final examination was 575.* Since then the number of appointments has increased largely, but the number of those who prepare themselves for this branch of the public service, has also increased, and many have to find employment elsewhere. Between 1860 and 1881 the mean age of those who obtained appointments as Oberförster was between 32 and 35 years. Further promotion to the grade of Forstmeister and upwards is entirely by merit, and a large proportion never advance beyond the grade of Oberförster.

Organization of Forest Administration.

The average area of a State forest district is 3,900 hectares, or 9,600 acres. But the area varies much in the different parts of the country. The extent of an Oberförster's charge is largest in the eastern provinces near the Russian frontier, where the demand for timber and other forest produce is less than in the central and western districts. In those provinces some forest districts contain more than 10,000 hectares, or 24,700 acres.

Each forest district is sub-divided into a number of beats, (*Schutz-bezirke*) under subordinate officers, whose chief duty is the protection of the forest, but who are also entrusted with a share in the executive management, subordinate to the Ober-

* These figures are taken from p. 222 of the excellent work, *Die Forstlichen Verhältnisse Preussens*, by Otto von Hagen, the late Chief of the Prussian Forest Department. (First edition, 1867).

förster, whenever circumstances render such advisable. There are on an average from five to six sub-divisions in each forest district.

Each of the 13 provinces of the kingdom is divided into a number of divisions *(Regierungs-bezirke)* with a Local Government, at the head of which is the "Regierungs Präsident." The province of Rhenish Prussia, for instance, consists of five divisions—Coblenz, Düsseldorf, Cöln, Trier, Aachen. In each of these divisions, as throughout Prussia, the chief Forest officer (Ober forstmeister) is a member of the Local Government, and the forests of each division are divided into a number of inspection circles (Forst inspection). Thus there are four such circles in the Regierungs-bezirke of Coblenz, one in charge of the Ober forstmeister, the others in charge of officers having the designation of Forstmeister. In each circle are included, besides the State forests, all other public forests which are situated within its limits. As stated in the beginning of this paper, the number of these inspecting officers, including the two Directors of the Forest School, is 122, and these appointments are filled by selection of the most skilful and capable among the officers holding the appointment of Oberförster. The same principle is followed in filling up the highest appointments.

To recapitulate, the Oberförster, aided by the subordinate officers, manages the forest district in his charge, and a number of forest districts are under one inspecting officer, who is directly subordinate to the Local Government of the Division (Regierungs-bezirke). The control of forest business in the kingdom is vested in the Secretary of State (Minister) of Agriculture, State Domains and Forests, and the Oberland forstmeister is Director of the forest branch of that Ministry. The work entrusted to the officers of the forest branch consists in tours of inspection; chiefly for the settlement of special questions, and in dealing with the forest business, which is sent up to the Ministry for decision by Local Governments. Subordinate to the forest branch of the Ministry are the office for forest surveys and working plans, and the Forest Schools of Eberswalde and Münden.

In order to complete the account of the work done by the Administrative Forest Staff of Prussia, it will be necessary to say a few words regarding the management of the communal and other public forests which are under the control of the Government. The extent to which this control is exercised, is regulated by law, and the law in this respect is different in different portions of the kingdom. In certain provinces, *viz.*, in the former kingdom of Hanover, the former Electorate of Hesse Kassel and the former Duchy of Nassau, most of the communal forests are managed by the State Forest officers, and are generally included in forest districts with the neighbouring State forests. Towns, villages and proprietors of these forests contribute certain rates

on the acreage of their forests to the expenses of administration. In the other provinces the control of Government is generally limited to the maintenance of the forest area, and their working according to conservancy principles. In Westphalia and Rhenish Prussia, the communal forests have been formed into administrative charges under a distinct class of officers (Gemeinde Oberförster), who go through a course of training similar to that of State Forest officers, but shorter, and who pass examinations, the standard of which is somewhat lower than that fixed for the administrative State forest service.

The control over the communal and other public forests is exercised by Local Governments, and matters which require reference to higher authority are dealt with both in the Ministry of Agriculture and State Domains and in the Ministry of the Interior. To the Ministry of Public Instruction are subordinate certain forests, which are the property of Colleges and similar institutions.

PAY AND ALLOWANCES OF ADMINISTRATIVE FOREST OFFICERS.

A few words may now be added regarding pay and allowances of the administrative forest staff in Prussia. The pay of the Oberförster ranges from 1,800 to 3,300 marks a-year (£90 to £165). In addition to this he draws a consolidated allowance, up to 2,100 marks (£105) a year, to cover the keep of horses and incidental expenses connected with the maintenance of his office. He is entitled to a free house, or compensation where there is no official residence, as well as to free fuel. Generally he is allowed free pasture for his cattle in the forest and a small farm, usually from 50 to 60 acres in extent, on his paying a nominal rent. On transfer from one appointment to another, an Oberförster receives £15 to cover the expenses of the move, in addition to a mileage rate of 8*s.* for 10 kilometres (6·2 miles) for the distance between the two posts.

Pay and allowances of the superior officers are higher in proportion. The Forstmeister (junior inspecting officer) draws from £180 to £300; an allowance for house rent, and up to £145 a-year as a consolidated travelling allowance, with additional daily or mileage rates for official journeys beyond the limits of his charge. The pay of the Ober forstmeister (chief inspecting officer of a division) (Regierungs-bezirke) is from £210 to £300, with allowances in proportion.

The pay of State Forest officers is small in Prussia, smaller than in some of the minor states of the German Empire, but the additional allowances are high in proportion, and distinguished service is promptly rewarded by titles, decorations and public recognition, by promotion, and in some cases by the grant of special rewards. Forest service is exceedingly popular among the best classes of society. Though here and there matters may not be perfect, there is no discontent, and it would be difficult

to find a body of officers more enthusiastically devoted to their profession and more efficiently prepared for its duties, than the administrative State Forest officers of Prussia.

In common with all superior State officers in Prussia, they receive suitable pensions after retirement, and their widows and orphans are well cared for. Invalid pensions are granted to forest officers at the rate of one-fourth of pay and those allowances which count for pension, after the close of 10 years' service, of three-fourths after 40 years' service, and at intermediate rates between 10 and 40 years' service. An officer may claim his pension, without any medical certificate, after having attained the age of 65 years.

In Prussia all State officers are required to contribute 3 per cent. of their pay and pensionable allowances to the General Widows and Orphans Fund. In return the State pays to each widow a pension, amounting to one-third of the pension which would have been due to her husband on the day of his death. Up to 18 years of age each orphan (whose mother is dead) receives one-third, and each child with the mother one-fifth of a widow's pension. The aggregate amount of widows and orphans pensions must not exceed the pension to which the deceased officer would have been entitled on the day of his death. In addition to this, the family of the officer receive his full pay during three months following the month in which he died.

Training of administrative Forest Officers in Bavaria.

In the other countries of the German Empire, the organization of forest business and the training prescribed for State Forest officers is similar to that in Prussia. A few remarks regarding the course of training in Bavaria, the kingdom next to Prussia in extent and importance, may not be out of place.

As in Prussia, candidates must have passed the closing examination of a public school (Gymnasium). There is no preparatory apprenticeship in a forest district, and they at once commence by attending the Forest School at Aschaffenburg during a period of two years. I may here mention that, in Saxony, candidates before commencing their studies at Tharand, are required to pass through a practical apprenticeship of six months.

At Aschaffenburg, mathematics and natural sciences are taught by five Professors, sylviculture, protection of forests, the art of shooting and hunting are taught by the Director, Forstmeister Fürst, assisted by the Oberförster in charge of the forest district (Klein Ostheim) which is attached to the school. After completing the course at Aschaffenburg, two years' study at a University is prescribed, of which one year must be spent at Münich. At this University has been established the insti-

tution for experimental forestry of Bavaria. It is under the control of the senior Professor of Forestry, and candidates for the administrative forest service of Bavaria must, while studying at the University, attend during one year the practical exercises at that institution.

After completing their studies, candidates present themselves for the first examination, and those who pass have to spend two years in practical work in selected forest districts. For this purpose the Government appoints from time to time instruction forest districts in the different provinces, which are in charge of officers specially qualified to undertake the practical training of candidates. During a third year candidates are employed on special works, or they are attached to the forest branch of a provincial Government, and during this period they usually receive daily allowances.

Having passed the first examination, completed the three years preparatory service, and having gone through his one year's military service, the candidate may present himself for the final examination, and when this has been passed, he becomes eligible for an appointment in the administrative staff. At present a great re-organization of the administrative forest staff in Bavaria is on the point of being carried out, but to enter into this subject would lead too far on the present occasion.

As explained, an additional year of studies is substituted in Bavaria for the preliminary apprenticeship, which is required in Prussia. On the other hand there is in Bavaria an additional year of preparatory practical service, but for the work done during this year, candidates generally receive some allowances. Thus in Prussia three years' practical work and three years' study are required from candidates, while in Bavaria four years' of study and three years' practical service must be completed, before candidates are admitted to the final examination.

Conclusion.

Candidates for the higher branch of the Indian Forest Service have hitherto been admitted on the ground of an entrance examination, at which in mathematics, natural science and modern languages, the standard has been about on a level with that of the closing examination at a Gymnasium in Germany, while Latin, Greek, history and geography were not included among the subjects of the examination. Two years-and-a-half were then allotted to the study of forestry, the auxiliary sciences and practical work in the forests. It is obvious that in so short a period the preparation for practical service could not be as efficient as in Germany, where from six to seven years are devoted to it. In France matters are somewhat different, partly because the French students who enter the Forest School at Nancy have previously attained a much higher standard in mathematics and natural sciences, than is required at the closing exami-

nation at a Gymnasium in Germany. Their subsequent professional preparation extends over three years.

When in 1866 I was permitted to organize a system of professional training in the State forests of France and Germany of young Englishmen specially selected for this purpose, I was well aware that two years-and-a-half would be too short a period to attain really satisfactory results. It was not, however, considered possible to assign a longer time to these studies.

My experience in India and in England has convinced me, that young Englishmen of the educated classes are by constitution and habits admirably fitted to make first-rate forest officers, and it must to a great extent be ascribed to the natural aptitude of young Englishmen for forest work, that such satisfactory progress has been made in the organization and management of the Indian State Forests, by officers, most of whom had not gone through a professional training sufficient to prepare them fully for the work to be done.

Hitherto forest work in India has been more of an administrative than of a professional character. As further progress is made, this will change, and new problems in cultural operations, the treatment of forests to secure natural reproduction, in regard to protection against insects and other enemies, and the elaboration of working plans will present themselves, which will tax the forester's skill to the utmost. I do not maintain, that what the Indian Forest officer has learnt of chemisty, botany and zoology and of forestry in Europe will directly help him, but the man who has entered into the spirit of scientific research, and who has become familiar with the results of methodical forest management in those countries, where forestry is best understood, will have a better chance of arriving at correct conclusions, and devising practically useful methods, than the man whose instruction in these matters has been imperfect.

In 1866 one main difficulty was, that sufficient facilities for acquiring the necessary knowledge in applied mathematics and natural sciences did not exist everywhere in Great Britain, and that it was therefore not feasible at that time to require at the entrance examination the same standard in applied mathematics and the natural sciences, which forest students are required to attain, before being admitted to the Nancy Forest School. Within the last 20 years this has completely changed. The instruction in science in Great Britain has now become so much developed, and so many more institutions for teaching science have been established, that, provided the subjects required are clearly defined, it would not be unreasonable to expect students to master the auxiliary sciences before admission to the professional training, and it would not be difficult to test proficiency in these branches of science by means of practically arranged examinations.

At the present time one of the difficulties in the way of a

satisfactory arrangement of this most important business may possibly be, that the number of those who have presented themselves at the annual entrance examinations, has lately not shown a tendency to increase, but rather the reverse. This may be due to the uncertainty regarding the new system which will be adopted in regard to the professional training of candidates. Or it may be due to the prospects of forest service in India in regard to pay and pension not being considered sufficiently attractive.

Had candidates of late years come forward in larger numbers at the annual entrance examination, it would not be difficult to raise the standard, and if their proficiency in natural sciences were tested, as is now commonly done in England for other purposes, by means of work done in the laboratory, a firm basis could be gained, whereupon to build a good system of training in forestry. But whether this plan is followed, or whether Government undertakes the teaching of the auxiliary sciences as well as of forestry, I have no doubt that the importance of good forest management in India will in course of time lead to such improvements in the prospects of Forest officers sent out from England in regard to pay and pension, as will induce promising young men to come forward. The development of an efficient system of professional training for the superior forest service will then follow as a matter of course.

When the organization of the Indian Forest Services has been completely carried out, Forest Rangers and other executive officers will probably occupy a position analogous to that of the class of Oberförster in Prussia. For a long time to come it will not be feasible to provide for Forest Rangers in India that thorough professional training, which administrative forest officers in Germany receive. So much more needful does it appear that the officers of the superior staff, who will be employed in the direction of affairs after having spent the first years of their Indian career as executive officers, should receive a complete scientific and professional training. The number of these superior officers is necessarily small, but for a long time to come the initiative in professional matters will mainly rest with them, and mistakes made by them will have far reaching and mischievous effect. They ought to be picked men, thoroughly familiar with the science and practice of forest management in Europe, and with the experience gained in forest administration in those countries where it is best understood.

D. Brandis.

FOREST PROTECTION IN AJMERE.

The following notes have been drawn up showing the results of forest protection in Ajmere.

Influence of protection on growing timber stock.—I have divided this into forest conserved since 1875, and forest conserved since 1883. In treating of the older blocks of Merwara, where the hill-sides were not clean cut, it is astonishing to see the marked difference between the coppice shoots, and young trees inside and outside the forest, the one growing quite straight with poles well adapted for household purposes, the other crooked and small. This fact has become so very marked, that the villagers even are not blind to it; and though averse to any extra trouble, they always send in an application to be allowed to cut the wood from Government forest, when they might cut it from the open forests round their villages (where such exist) with little or no trouble. The reason being, as they themselves say, that they get good, straight and sound poles from the forests. The inferiority of the growing stock outside is due here to excessive lopping, chiefly for grazing. Fires do no damage, as there is no grass to burn. During my inspection of the Marwar forests last year, I was agreeably surprised by being asked by some of the villagers on the outskirts of the Todgarh range, to allow them to cut poles and plough shares from Government forests. This appeared strange, and on questioning them, I was told that the wood from the *Sirkari* forests was very straight and sound and of a superior quality; there was no disputing this point, even though the stretches of hill-side covered with forests in which these villages lie, are much larger than the Government forest. This inferiority of the growing stock can only be put down to fire and grazing.

The following extract from my report on the Jodhpur forests supports this view:—

"It is the interest of the Istimrardars and villagers to protect their forests from fire, not with a view of bettering the growth and obtaining a better quality of grass, but because these tracts supply all the grass upon which the cattle subsist during the summer months, and if this were lost, and the season at all a bad one, the country would fare very badly. Knowing this, I was pleased to hear that when a fire breaks out in an Istimrardar's forest, all hands are ordered out to try and extinguish it, but then with all their good intentions no amount of help can extinguish a forest fire in these hills without a proper system of fire conservancy. * * * * The forests have suffered very badly from fires. Last year a very disastrous fire swept through the whole of the forests south of Kot (bordering the Government forest at Dawer), leaving numerous burnt stumps to tell the tale. Matters are only made worse when a forest is preserved for two or three years, and then allowed to burn. The rubbish collected only helps to make the fire burn fiercer, doing far more damage than otherwise; as has been painfully illustrated in this case. It was pleasing to see the contrast in the Dawer Government forest, where a fire-line helped to check the fire."

Regarding grazing in these forests, the following is also taken from the same report:—

"At present there are no restrictions to grazing both of horned cattle, sheep, goats and camels. I was much distressed to see the damage done by sheep and goats, which, when fodder is somewhat scarce in the plains, come up in large herds into the hill forests to graze. Camels also wander in large troops through these hill forests, doing no end of damage; so that altogether the forests are slowly but steadily going from bad to worse."

In conclusion, I would here remark that the principal wood used in these parts, both for household purposes, for fuel, and to a certain extent for agriculture, is *Anogeissus pendula*. This tree, though found here and there in the Ajmere District, is very plentiful in the lower three-fourths of the Merwara District, forming nearly the whole growing stock of the forest. It is very sensitive to ill-treatment, and where continually cut and grazed down by goats and camels, I have actually seen it assume a prostrate form over considerable areas, lying quite close to the ground. The whole of the hill-sides along the road to Todgarh in the Merwara district illustrate this.

In dealing with the forests conserved since 1883, I am able, through personal observation, to state with confidence, that the change in the growing stock of these blocks, through keeping out grazing and fires, has been very great. I will deal with the worst stocked block of those taken up—the Makerwali Hokran one, situated three miles from Ajmere. The growing stock of this block consists chiefly of *Anogeissus pendula*, *Rhus mysorensis*, a few *Grewias* and *Euphorbia*. I recollect how astonished I was on my first visit to this tract to see the very peculiar way in which one and all of the above plants, except the *Euphorbia*, were growing. I cannot better describe them than as low, thorny, patchy scrub, each bush being nearly flush with the ground, only half a foot high and 4 feet across, with little or no leaf on the outside, and covered with what appeared prickles, but which were really the ill-treated branches quite hardened. All this was due, first to the growth being cut down, and then to the coppice shoots being grazed over by goats and sheep. This was the state of the growth before the block was taken up as a forest reserve. The results even after so short a time of conservancy have been marvellous. Out of these prickly patches numerous straight coppice shoots have sprung up; in some cases as high as 2 or 3 feet, while the entire bush is covered over with leaf. The growing stock of the other block lately conserved is very promising. Good healthy shoots being thrown out compared with the short stunted ones in the open forests which are continually being grazed over.

Reproduction.—Under this head I can safely say that there is little or no reproduction in the open forests of both the Ajmere and Merwara districts. While in the protected areas, closed to grazing and fires, the number of seedlings of different ages are

very numerous, in fact in places they literally cover the ground wherever there are any seed-bearing trees. Of those which exist in any great numbers I may mention dhau, saler, kumpta (*Acacia rupestris*) and khairi (*Dichrostachys cinerea*). This chiefly relates to the Merwara district. In Ajmere the hill-sides and plains have long ago been very nearly cleared of all growth except *Euphorbia*, so that the reproduction is carried on to a great extent under different circumstances. Here the *Euphorbia* takes the place of foster-mother, and under its friendly shade hundreds of seedlings, sprung from seeds carried by wind and birds, may be seen. Out of all the stretches of *Euphorbia* in the open forests few or none of these seedlings appear, while in the protected blocks nearly every *Euphorbia* shelters a plant beneath it, and in most cases even after such a very short time of conservancy, this plant overtops it.

Of late whole stretches of *Euphorbia* in the open wastes round about Ajmere are being cleared, not for the purpose of making the land available for cultivation, but merely for sale. The consequence is that the land has been laid quite bare, and where I recollect a couple years ago having seen a few *Acacias* and nim cropping up over the *Euphorbias*, there is not a trace of any description of tree growth, and little or none of grass and scrub.

Adjoining the Government forest in Merwara are the Marwar forests of an area much larger than that of our reserves. In inspecting these forests last year I could not help being struck with the great want of established seedlings, which were few and far between, though there was by no means a lack of seed-bearing trees. This was easily traced to fires from the appearance of the scorched trunks scattered all over the forest. Last year the greater part of these forests were preserved against fire, and numerous seedlings have sprung up during the rains; but this is of little value when perhaps the fire of next year or the year after will destroy them all. One other point in connection with reproduction by seed I would mention, and that is the reproduction of khair. This year I saw numbers of seedlings of this tree within our protected forest of the Merwara district. The khair is by no means found in any quantity in these forests, but from the results already obtained in the number of seedlings now beginning to show, the feature is very promising. On the other hand, when going through the Marwar forests, where there are considerable areas of pure khair (now fast disappearing), I did not come across a single seedling even after a very careful search; this appeared to me to be chiefly due to forest fires, which have of late years been very severe in this part of the Jodhpur forests.

The reproduction by coppice shoots has been dealt with at some length in dealing with the growing timber stock. The results obtained by experimental cuttings, though only 2 to 5 years

old, have been so very encouraging, that large areas have been selected for coppice yearly—this will enable a good deal of the previous ill-treated stock to be got rid of. The following gives the average measurement of coppice shoots :—

Cut 5 years ago—

Dhankra (*A. pendula*); girth 6 inches, height 10 feet.

Cut $2\frac{1}{2}$ years ago—

Babul; girth 6 inches, height 10 feet.

Arinja (*Acacia leucophlœa*); girth 6 inches, height 8 feet.

Khejra; girth 7 inches, height 12 feet.

Cut 3 years ago—

Saler; girth 6 inches, height 8 feet.

Undergrowth. The undergrowth consists chiefly of *Rhus mysorensis* and *Zizyphus Nummularia* and a species of *Indigofera*, which is fast covering the ground in all the Ajmere protected forests.

Though found in the outside forest it is fast disappearing there, whole areas being cut and the roots dug out for sale.

In the Merwara blocks, except where blanks and saler, gol and other open forests exist, the undergrowth is not very luxuriant; as *A. pendula*, owing to its dense shade, does not allow any undergrowth except a few grasses to grow under it. In the outside forests there is little or no undergrowth.

Grass.—In this lies the great value of these reserves. The immense help which these forests afford to the agricultural population of this district is only really appreciated in years of scarcity. It will always be a matter of regret that the area of these forests is so small, and that they cannot be farther increased without placing undue pressure on the villagers. The village reserves, which may be styled district grass reserves, will soon be started. These if managed according to the plans laid down, will help us somewhat out of the difficulty. It is a matter of doubt however, whether the villagers, who are to have the management of these reserves, subject in some degree to the control of the District officer, will take a proper amount of interest in their own affairs. The experiment is nevertheless worth trying.

At present with regard to the open wastes, grazing is in a very bad way. The cattle lead a most precarious life, dependent solely on the state of the rains. Even with a very good rainfall, from indiscriminate grazing, there are very few places where the grass is allowed to grow up, so as to be of use during the winter and summer months. The consequence of this is that these open wastes produce less grass year by year, leaving large open blanks without a vestige of any vegetation; a very unsatisfactory state of affairs.

With regard to the reserved forests the state of affairs is quite different. Whole hill-sides are covered with a very luxuriant growth of grass, which is increasing year by year, for

on several occasions, I have noticed hollows on the tops of bare rock, into which rubbish has been blown, this has now formed mould, and grass has sprung up evidently from seed blown there by wind. The following extracts, taken from my annual report for 1884-85, may be interesting, as they go to show the advantages gained by the villagers in the protection of these reserves :—

"Owing to the very short monsoons of 1883 and the scarcity of fodder in the open village forests, the whole of the Merwara tracts were thrown open to grazing. In Ajmere wherever the villagers applied for grazing, grazing was allowed them till the rains set in; by this means many cattle that would otherwise have perished from want of food were saved. * * * The number of cattle admitted into the forest to graze were 13,086 compared with 5,279 allowed to graze the previous year. Villagers who had no rights within the protected areas were also allowed to take advantage of the Government reserves. The following figures are quoted from the same report to show the value of the grass cut and carried away by villagers free from these Government reserves :—

Name of District.			Head-loads brought out from forest.	Value, Rs.
Ajmere,	..	..	210,000	13,125
Merwara,	..	..	530,000	33,125
Total,		..	740,000	46,250

"The figures for the number of head-loads in Ajmere is very nearly correct, for Merwara a fair approximation has been taken. Regarding the value of the grass the low sum of 1 anna per head-load has been fixed."

Influence of improved forest growth on the water supply.— Before dealing with any one of these heads, I should like to mention that the results at present obtained, as far as the water supply is concerned, are still in their infancy, and do not prove anything one way or the other. I do not believe that there is any part of India more favourably situated than this district for the experiments undertaken, and I have not the slightest hesitation in saying that another 10 or 15 years will see us in a fair way to definitely decide many of the different questions now brought forward. I will now take up each head.

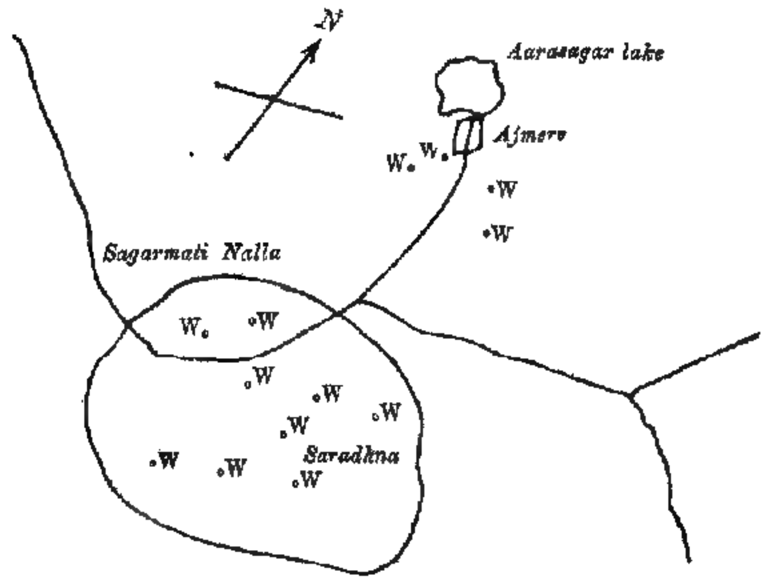
Continuity and supply of water in springs.—This experiment has only been started this year. The difficulty being in finding suitable springs among the dry hills of this district. In almost every case where they exist, the forests have been more or less untouched, owing to the vicinity of some temple or another. I may here mention that it is a custom in these parts to preserve all trees round about temples. These are considered

sacred, and ill-luck is supposed to overtake those who even cut a branch.

Only in the case of two springs situated in the Bari Nal and Imli Kund, both in the Táragarh block, have anything like definite results been obtained. The following is an extract from Mr. Moir's report when the block was first taken up:—"The greater part of this tract when taken up, was altogether barren and denuded of tree vegetation." Such is by no means the case now; in fact the Bari Nal and Imli Kund portions of this block, comprising more than three-fourths of the area of the block, is so completely clothed with seedlings and coppice shoots from 4 to 6 feet high, chiefly of saler, that there is not the slightest necessity for artificial planting just at present, and all this in 9 years only.

To return to the springs. When in 1883 I visited the place both springs were running, even as late as the beginning of May. When noticed by me again after the rains of 1883 (the monsoon was partly a failure in this year, the Ajmere register showing only 17·40 inches), the springs were running up to December, when the Bari Nal one dried up and Imli Kund had very little water in it. After the rains of 1884, which were exceedingly good, the Bari Nal spring was completely dry by the end of September, and the Imli Kund nearly so. The streams on the banks of which these springs are situated only ran once, though the rain was very heavy at times. During the present monsoon, which is exceedingly good with very heavy falls of rain at times, the Bari Nal spring is perfectly dry, and not a drop of water has come down from the hill-sides to enable the stream to flow. I may also mention that a well situated not far from the spring has also dried up during the hot weather, and with all the rain we have lately had, has not a drop of water in it. Regarding the Imli Kund spring there is just a little water, and if the present rate of drying up goes on, the spring will cease altogether next year.

Now I have no doubt that the benefits derived from the moisture percolating into the soil within forest limits does good to some wells outside, but at present it is still an open question how far from these limits this good extends. After careful observation I have found that none of the wells situated outside, close to this forest, have derived any benefit. To illustrate how very difficult is this question, of percolation affecting wells, I will mention one of many cases, where after a very long experience it has been found that the wells situated within the vicinity of a very large tank, the Ana Sagar, are benefitted but slightly, while wells 10 to 11 miles away are really those which derive benefit from the water of this tank. The accompanying sketch gives the relative positions of these places. The experiments now being started in connection with wells and springs will, I hope, tend to the solution of the problem.



W. Wells deriving little or no benefit
W. Wells deriving a great deal of benefit.

Sudden floods.—In treating of this head there is no disputing the point that forest growth has checked sudden floods. Numerous illustrations of this can be seen in all the forest blocks which have been conserved for the last 9 years. One or two examples will suffice; for instance, the Táràgarh block which has been referred to in reference to springs. That the Bari Nál stream came down with a great rush before the forests were taken up, is proved by the remains of an old band which has been breached by the sudden floods, whereas now the water barely flows through it. Again, in the case of the Madár hill block, on the north-east of Ajmere, and within half a mile of the station, half of the hill has been conserved since 1876, the other half has remained open. The difference is surprising between these two halves at the time of a good shower of rain. While the water is running in torrents down the ravines on the open side, very little water is seen running down the ravines in the protected area.

Collection of water in tanks and wells.—With reference to tanks, the matter is still an open question to be proved or

disproved by the experiments now started. Only in one case in this district, and I might almost safely say in the whole of India, has the entire catchment area of a large tank been taken up as a forest reserve. The tract is situated midway between Ajmere and Nasirabad, and has an average rainfall of 20 inches. It was conserved in 1880, and the results have been anything but satisfactory, and decidedly at present against the idea that an increased supply of water in tanks results from an improved forest growth. A short description of its present state will, I hope, not be out of place. The geological formation consists chiefly of mica schists and quartzite very much broken up. The soil along the nallas is good and fairly deep, with water close to the surface. On the hill-sides the soil, just forming, is shallow and somewhat poor. The whole tract is covered over with a most luxuriant growth of grass, with numerous seedlings of nim, arinja, siris and babul cropping up out of the *Euphorbia* bushes, which are very plentiful. The seed-bearing trees are few, but nevertheless natural reproduction is good. The tract has lately been taken up for artificial reproduction, and the results of the last two years are exceedingly promising. I will now proceed with the matter connected with the supply of water to the tank situated at the east entrance of the forest.

The Nasirabad Cantonment Committee have lately been urging that the growing forest has been doing much damage to their water supply, which is taken from this tank, and though the rainfall last year was greater than for the year in which the tank was constructed (1877), the quantity of water which came into the tank has only been a tenth of what came in in 1877. The following figures are given by the Executive Engineer in charge Military Works :—

Practical Results, Danta Tank.

Year.	1878.	1879.	1880.	1881.	1882.	1883.	1884.
Rainfall at Danta, ..	18"	20"	12·64"	15·22"	23·38"	18·14"	18·70"
Quantity of water fallen into catchment area, in million c. feet,	110	122	79	92	141	84	115
Quantity collected in the tank, in million c. feet, ..	30½	20	7	11½	13¼	1¾	8¼
Percentage of rainfall collected, in million c. feet, ..	0·28	0·165	·09	·12	·096	·02	·03

Remark.—Area of Danta catchment 1,688 acres (about 2¼ square miles) = 73,539,475 square feet.

These figures are not satisfactory, but it appears that the tank received very little water from the monsoon of 1884. The monsoon of 1883 was nearly a failure, and owing to this the tank dried up early in January; so that when the monsoon of 1884 set in, the first showers went simply to moisten the soil which had been parched during the hot weather. The evaporation from the dry hot catchment area was also enormous; so that all the light showers had no other effect than to wet the outer covering a very little, but caused no flow. From experience it has been found that a fall of less than 1½ to 2 inches in 24 hours does not assist in filling a tank. Judging from the very satisfactory way in which this block is progressing, both in artificial and natural seedlings, I have no doubt that in a very few years more water will be retained in the soil for sub-surface flow. The evaporation from the surface of the tank has been calculated to be ⅘ths of the water coming into the tank, and as the air is rendered moister by the continual evaporation of the foliage, there will be less evaporation from the surface of the tank, which will become more and more shaded along its borders by the forest growth. There is also the hope that there will be a considerable quantity of sub-surface water gradually flowing into the tank as the cover overhead increases in the catchment. With reference to wells, it appears from general observation, though the matter still requires to be proved by experiment, that the water level in all the blocks has been considerably raised by forest conservancy. This seems notably illustrated in the case of the well in the bed of the Danta tank, which is brought into use when the tank happens to dry up. Though a very considerable quantity of water was taken from this well in pipes during the hot weather of 1884, for the Nasirabad cantonment, the water level at the commencement of each day was very little lowered, showing that the whole time the sub-surface flow was maintained. I have also noticed that in wells dug within forest limits water was found at a very much higher level than in wells outside, even though the stratification and general conditions were very nearly similar. As an example in point, I may mention the case of the Danta block, where three wells have been dug in one of the streams within forest limits. Water was found in every case at a depth of not more than 15 feet, whereas at the base of the western slope of this same range, and where the rock and soil are very similar, with the stratification somewhat the same, but with the hill-side nearly bare, and with little or no grass, the water was reached at a depth of 25 feet. There is no doubt that the experiments now undertaken will give valuable results in a few years.

Precipitation of moisture.—Under this head I cannot do better than give the results of last year taken from the rain-gauge stations established in and out of forest limits.

Month.	Mohwabir, Area of Forest 1,882 acres.				Madar hill, Area of Forest 980 acres.				Nag Pahar, Area of Forest 2,680 acres.				Bajrangarh over the Ana Sagar band.	
	In Forest.		Out of Forest.		In Forest.		Out of Forest.		In Forest.		Out of Forest.			
1884.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.	In.	C.
June, ...	4	42	9	75	2	45	2	54	...	...	...	...	2	27
July, ...	7	88	7	...	4	75	4	52	5	...	4	12	6	24
August, ...	4	86	4	14	6	67	6	68	4	58	4	72	3	82
September, ...	10	37	10	10	12	17	12	34	9	67	7	53	9	96
October, ...	...	2	...	2	...	...	...	...	...	..	..	...	...	11
November, ...	...	22	...	25	...	22	...	19	...	8	..	11	...	20
December, ...	...	...	...	...	...	2	...	8	..	...	...	...	...	...
Total, ...	27	72	25	26	26	28	26	80	19	33	16	48	22	60

Remarks.—The stations were only erected in June, so that this does not show the total rainfall for the year, as rain fell in January, February, March and May.

In Mohwabir the distance between stations is 1,282 feet.

In Madar hill " " " 2,161 "

In Nag Pahar " " " 9,195 "

Before any definite and reliable results are obtained these experiments will have to be steadily carried on for a number of years, owing to the rains of these districts being so very local. A difference in the rainfall of as much as 6 inches during the year, between places not more than 10 miles apart, is by no means an uncommon occurrence.

Counteracting erosion, preventing landslips, contraction of beds of water-courses, &c.—Here the closed areas show a very marked improvement, each block affording numerous illustrations under the above heads. Whole sides of spurs, that three years ago consisted of nothing more than a heap of broken stones, with all the soil washed out of them, not affording sufficient nourishment for the growth even of grass, are now fast becoming covered not only with grass but with numerous seedlings. The Rajgarh and Danta blocks afford numerous examples of this. I have no doubt that the older conserved blocks, now fairly well covered, were more or less in the same state as the new blocks. Traces of the broken patches of rock can still be seen on a close inspection. There is also not the slightest doubt that the protection of forests has contracted the beds of water-courses, causing the water that flows from the hill-sides to run in a narrow definite bed, the rest of the original stream being

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covered over with deposits of silt, which is covered over with grass and numerous seedlings. The Mendi-khola in the Mohwabir block affords a most striking example. Where the stream runs through forest lands, and a hundred yards below, it was nearly 80 feet wide at one time, but has now silted up very nearly to the top, with only a very small channel for the waterflow. Beyond this, where numerous small streams, not under protection, join the main stream, the bed maintains its original width, with a rocky or stony bottom.*

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ON TOUR WITH THE STUDENTS OF THE FRENCH FOREST SCHOOL IN THE VOSGES AND JURA.

BY A LADY.

After experiencing a few days of great heat at Nancy, we were not unwilling to exchange it, on the 24th of May, for the fresh breezes of the Vosges mountains. We were a large party, 37 in number, including students and professors.

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* The following notes from Ebermayer :—Die Physikalischen Einwirkungen des Waldes auf Luft und Boden, *will illustrate* the subject.

	Quantity evaporated in cubic inches from a square foot of surface.					
	Free water surface.		Soil with no undergrowth or grass.		Soil with undergrowth, grass included.	
	Maximum.	Minimum.	Maximum.	Minimum.	Maximum.	Minimum.
Out in open,	17	2	15	6	..	..
In forest, ..	7	1	7½	1½	3	1

(a). Forest growth without immediate ground covering reduces the amount of evaporation as compared with evaporation from an open field 62 per cent., and the evaporation under forest is 2·6 times less than in the open.

(b). In the open the immediate ground covering diminishes the evaporation from the soil by 22 per cent. at the most, and 1·3 per cent. at the least.

(c). Forest and the immediate ground covering together diminish evaporation by 85 per cent.

(d). Evaporation from forest with immediate ground covering is less by 60 per cent., or 2½ times less than from a forest which has no immediate ground covering.

In other words :—

If 100 volumes are evaporated from the soil out in the open, forest without immediate ground covering evaporate 35 volumes, and forests with immediate ground covering 15 volumes.

If forests without immediate ground covering let out into the air 100 volumes, forests with immediate ground covering let out 40 volumes.

At first there was nothing remarkable along the route, but after leaving Laveline, the train ascended the valley of the Volagne, and every turn brought us into prettier scenery, the hills on both sides being covered with fir trees, looking their brightest and best with the young shoots of spring fresh upon them. We were amused at the salute bestowed on the *sapins* (silver fir) by the students, who, following the lead of the professors, took off their hats as we passed the first trees of this species and entered the forest. The railway was bordered on either side by close cut hedges of spruce fir, which looked very neat and trim.

We reached Gérardmer in the evening, after a shower of rain had freshened the ground and rendered the air very cold and keen after the last few days of heat. The *Hotel de la Poste* has a fine dining-hall capable of seating 150 people, and a splendid *salon*, with a polished oak floor, most tempting to the lovers of the dance. We were informed that the piano had been removed on the arrival of the students, lest they should be tempted to indulge in the "light fantastic" in heavy boots, to the detriment of the polished boards.

There is a nice garden attached to the hotel, and beyond it some fields of wild flowers, which are very abundant and beautiful in Gérardmer, and then comes the lake, which forms the chief attraction of the place. The eastern extremity of this sheet of water is somewhat open, but the western end is almost enclosed by hills, rising out of the water, and thickly wooded down to the water's edge. There were some steady-looking flat-bottomed boats plying on the lake, which seems to abound in fish, many being seen disporting themselves on the surface of the water in a manner most tantalising to an angler who had left his tackle far away in England.

We took but a cursory glance at our surroundings that evening, but the next morning, while the students were engaged in triangulating the country, we strolled out to look about us. Gérardmer is a summer resort something in the style of an Indian hill station, but with this exception that an Englishman is seldom to be seen there. It receives an occasional visit from an English cabinet minister, but such a thing as a Cockney tourist is unknown there. It is evidently a favorite resort of French people, for the charming landlady assured us that they seldom have an empty room during the summer. This may in some measure be due to her influence, for her bright smile and cordial welcome were very attractive. The cheerful manner in which the landladies of the various auberges in the Vosges render their willing services seems to be characteristic of that region, and compensate the traveller to a great extent for the somewhat rough and ready appliances placed at his disposal when visiting the smaller towns or villages. But at the Hotel de la Poste the arrangements are perfect, and the visitors are

made thoroughly comfortable. Grouped round the eastern end of the lake, are some very pretty villas, standing in their own flower gardens, which extend down to the margin of the lake; but these were as yet unoccupied, their owners being unwilling to relinquish the attractions of the towns at this early stage of the season.

It is an easy walk of an hour and-a-half on well kept paths round the lake, but to our amusement a section of the French Alpine Club, which arrived during our stay, found it necessary to engage all the available carriages to enable them to make this little promenade. In front of our hotel stood a very fine elm tree, planted 200 years ago, to which we looked in our rambles on the adjacent hills as a landmark to guide us home. The annual fair took place while we were there. The single street presented one morning a lively appearance, being lined with booths which seemed to have sprung up in the night. The men in blue blouses and the women in white caps and aprons, all shod with noisy *sabots,* praised their rough wares as we passed, and tried to induce us to believe that the like were not to be found elsewhere. Their chief merchandize seemed to consist of pigs of all sizes and qualities, but all alike in their determination to go in a contrary direction to that in which their owners were trying to drive them, and contributing in no small degree to the noise of the fair.

There was a sad *finale* to the two days' amusement; some of the travelling shopmen who had imbibed rather freely had a disagreement, which ended in the murder of one of them, and in the arrest of another, who, however gave himself up without attempting any resistance. The next day a number of officials came down to make the necessary enquiries, which were soon over, and after the table d'hôte dinner these gentlemen left by the evening train.

We went for an excursion to a pretty place called the *Saut des Cuves*, a small foaming torrent which tumbles headlong down its steep rocky bed; though not large, it forms, with the rustic bridge thrown across it, a pretty picturesque scene. Not far from it, is a large flat stone which bears Charlemagne's name, and on which he is supposed to have rested his weary limbs, but whether that ancient warrior ever really sat on it is a question on which it is difficult to speak with certainty. Then we wandered on through the beautiful fir forests till we came to another rustic bridge called the *Pont des Fées*. The *Club Alpin Français* takes the greatest care that the unwary traveller shall not lose his way, for at every turn one meets with notice boards pointing out the direction in which the visitor should go in order to reach the various objects of interest, and also the way home, in case he should feel at all fatigued by an excess of beautiful scenery. Even the smallest streams and forest glades have been named by the club, and we several times found our-

selves hunting for cascades or torrents to which the boards guided us, the little trickles referred to having passed unnoticed under our very eyes.

We went with two of the professors to visit two interesting manufactories, one for converting wood into pulp for the making of paper and the other for making felt.

The wood used for the pulp consisted of round pieces of fir, 1 metre long and 8 to 9 inches in diameter. Each piece is cut into three billets, by means of a circular saw, and these short lengths are then put into a machine which shaves off the bark and leaves the wood clean. The knots are then bored out with an auger, and the round block split into two pieces. These billets are then pressed against a revolving stone in a hydraulic machine, the result being that the whole substance of the wood is reduced to fine atoms held in suspension in the water. This water is then passed through various strainers to remove all larger particles, and it ultimately appears simply as turbid water. The water is then strained off leaving a wet pulp, which is spread upon cloth and pressed between rollers so as to dry it. The flakes of dried pulp are exported to be used for making paper. All the constituents of the wood are in these flakes. We could not ascertain anything about the cost of the work or the profits made, but the woods used are spruce and silver fir, the two species being kept separate as they yield pulp of different colours.

After this we proceeded to inspect a felt manufactory. The wool was spread in very thin layers, one over the other, to make a thick soft mass, and this is pressed with water between rollers into a close substance. We saw hats formed on revolving blocks in the same manner. Rolls of felt were also made for shoes, and we were shown a piece of felt of graduated thickness made for the hammers of pianos, the price of which was about 125 francs per square metre.

The great industry about Gérardmer seems to be the making and bleaching of linen. The eye is attracted by conspicuous patches of white which cover large parts of the fields in all directions. There are yards, one might almost say miles, of linen spread out to bleach in the sun while it is kept constantly wet by a man in charge. Near the linen are seen small sheds, not unlike those from which the Himalayan hillman watches for the bears during the ripening of his crops; but they are to shelter men who guard their property against any human foe who might feel inclined to appropriate the linen. Every little cottage seems to contain a loom, and the peasants one meets leaving the town are generally carrying on their backs loads of linen thread, which they convert into cloth in their cottages. We visited a large factory, employing numbers of hands, where we saw the linen pass through all stages until it was completed. It was an interesting, busy scene, but very deafening, and one

could not interchange a word on account of the din caused by the machinery.

We went into an unpretending little shop to purchase a railway guide, and to our surprise discovered that the proprietor was an author, with his own printing press; he was very anxious to dispose of his books, telling us that the last Englishman who came to his shop took dozens away to circulate in England, and evidently implying that we might do the same.

We visited the church, which contains the usual number of little niches with draped figures of the Virgin, and does not differ much from other French village churches.

We must not omit the cheeses which form one of the principal productions of Gérardmer, and which always made a most obnoxious addition to the otherwise good table d'hôte dinner. Even at a distance one wished them further, and in self defence we were compelled to request the waiter never to present them to us.

Another speciality of the place is the walking stick made out of stunted fir trees with the end turned round to form a handle. The peasants cut them down, hang them for a winter over their kitchen fire till the smoke has browned them a dark colour, then add an iron spike and polish them for sale. They are more curious than pretty, but prove a most useful companion for a mountain climb. The great excursion from Gérardmer is to the top of the Hohneck. The carriage road winds through the beautiful valley for some miles, almost every turn opening fresh scenes of beauty before the traveller's eyes, it then turns upwards to the pass by a series of zigzags, whence is obtained the finest view of all looking down on the two lakes, Longemer and Retourmer, which lie embosomed in fir-clad mountains rising straight from the water and seeming to guard them on all sides. The drive terminated at the pass, *La Schlucht*, where there is a prettily situated inn, the view from the windows of which reminded us a little of the Himalayas, though the mountains are not nearly so grand. As a rule, the Vosges mountains are characterized by round topped hills covered with bright green grass which the cattle keep close cropped. Here the crest of the ridge forms the present boundary between France and Germany, and along it a line is cut through the forest, or a ditch is dug where no forest exists, the line is also marked at intervals by small square granite pillars, bearing an (F) cut on one side and a (D) on the other.

We walked up the Hohneck (4,500 feet) guided by the ever-faithful boards of the Club Alpin Français, and we ought to have been rewarded for our climb by a good view; on a fine day one can see the Bernese Alps from here. The fates were, however, against us, for though at first the sun shone brightly on the valleys of France, those of Germany were shrouded in mist, which soon overspread the whole landscape; but a glimpse

through the clouds enabled us to see the town of Münster which is situated in a picturesque hollow below.

The sward was lovely, being covered with alpine flowers, conspicuous amongst which were the large white anemone and the dark purple pansy, which grows luxuriantly all over the Vosges mountains. We should have liked to spend a long time gathering these mountain treasures, but the ominous clouds and distant rumble of thunder warned us not to linger. During our drive we had passed through large forests of silver fir and spruce; these in the higher regions give way to stunted beeches, which the cattle have reduced to a very poor condition by their constant browsing. It was very cold on the hill tops, and in sheltered places snow was lying, some of which will probably remain throughout the summer. On our way down we interviewed a cowherd, and found he spoke only German. This is a splendid pasture country, the grass being so nourishing that the cows require no other food, and on all these mountains, the butter is always good and rich; in the most primitive of auberges, producing the sourest of bread, we could always depend upon the beautiful butter. The clouds, which had been threatening all the morning, burst upon us before we regained the inn which stands on the very boundary line between France and Germany, and we were very glad to avail ourselves of its shelter. Several other travellers more or less wet came trooping in, and we were amused to see how the Frenchmen arranged themselves round the table on the French side of the room, while the Germans occupied that on the opposite or German side, there being no intercourse between the two tables.

Our drive back to Gérardmer was unfortunately made through pouring rain. We took another road which passed along the margin of lakes Longemer and Retourmer, the view of which from above had so much enhanced the beauty of the scene on our way out. All we could now do was to peer occasionally at the prospect from under the hood of our carriage. We could not summon courage to run 100 yards through the heavy rain, to see a cascade, which, from the numerous photographs one sees of it, must be very pretty.

The next day was Whit Sunday, a great day at Gérardmer. In the morning there was a Confirmation, an event which only takes place there once in three years. They had a cold bleak day for it, and the white muslin apparel donned by the young candidates looked very unseasonable. The youth of Gérardmer having been confirmed in the morning, made the most of their day by devoting themselves to skittles in the afternoon, and to a theatrical performance, consisting of *La Fille de Madame Angôt* and other pieces, in the evening.

We had a delightful scramble in the afternoon, gathered more beautiful wild flowers, and what is even prettier, the

sprays of pink feathery grass which are found all over the Vosges, and which give the fields a rosy tint. We found the view towards Remiremont very pretty, and we wandered on, following the notice boards of the C. A. F., in search of *La Vierge à la Creuse*. By enquiry we learnt that we were in search of a rough stone, bearing an exceedingly rough painting of the Virgin, which we had passed as unworthy of special notice.

Whit Sunday is a great day with the Club Alpin Français, and they mustered in force for dinner, occupying a table specially prepared for them. The party, about 50 in number, consisted more of ladies and children than of men, and when we saw them we were not surprised at their having requisitioned all the carriages to make the tour of the lake.

The next day we took a walk with some friends to hear a remarkable echo, and then said good bye to Gérardmer, and left to join the junior Forest Students class which was on its way to another part of the Vosges and the Jura to study sylviculture under its professor.

Having spent a very pleasant fortnight at Gérardmer, during which the *Anciens* were engaged in surveying, we started for St. Maurice, joining on the way the *Conscrits* with two of the professors; and now, after a stay in the luxurious hotel at Gérardmer, hard walking with comparatively rough accommodation was to be the order of the day. We were unfortunate in having the most deplorable weather, which robbed our ramble in the Vosges of much of its pleasure. Our party, about 40 in number, put up at the Hotel de la Poste, which seems to be the favorite name of the hotels about here, and after an abundant but somewhat rough dinner we retired early, as we were to make a start at daybreak for the ascent of the *Ballon d'Alsace.* We breakfasted at 6-30, and then immediately commenced the ascent. The sky was overcast, and we were hoping earnestly that the clouds would clear off, and that we should see from the summit the beautiful view of which we had heard so much. But we were doomed to disappointment, for about an hour after we had left the hotel the rain came down, first lightly, then heavily, and all hope of the view melted away.

On our way up we entered a dense forest of silver fir. Here the director stopped to lecture, and explained that the chief enemies the trees had to contend with were wind and snow; he advocated that some of the dominant poles should be thinned out, where they stood close together, so as to render the top of the forest undulating instead of its presenting a solid table-like surface on which the snow is apt to be retained until the trees are broken by its weight. The poles are readily sold for conversion into paper pulp.

On our emerging from the forest the rain seemed much heavier now that the friendly trees no longer intervened to shelter us. Beside the road we saw a cross, erected to the

memory of a poor man who had been lost in the snow in 1867, and a little further on another to commemorate the death of a man who had been murdered there in 1850. The ground was covered with wild pansies, growing as brightly and as luxuriantly as they did on the Hohneck. The rain at last came down so heavily that we were compelled to avail ourselves of the shelter of a very rough mountain auberge, where, however, we obtained some excellent butter and Gruyère cheese, which, with the cold meat we had brought with us from St. Maurice, made a capital breakfast; but we Indians rather missed the services of the *Khitmatgár*, and the hot breakfasts that seem so easily produced at any part of the jungle. After this we continued our weary ascent through clouds and rain to the summit, and having waited in vain for a glimpse of the magnificent view, we descended the hill by another road. For a few minutes the clouds cleared and we saw one of the outworks of Belfort in the distance. Here, as on the Hohneck, the Franco-German frontier boundary follows the crest of the hills, and is marked by pillars and ditches. On our way down we visited the forest house, which is very prettily situated overlooking the beautifully wooded valley, and a gun was fired that we might hear the echo reverberating through the hills. We returned after this to St. Maurice, and were glad to find our boxes, which enabled us to change our wet garments and indulge in a cup of tea before starting by train for Remiremont, where we arrived in time for dinner. We were such a large party that we dined by ourselves instead of joining the table d'hôte. The director stood champagne to the whole party, healths were drunk, speeches made, glasses clinked, and every one appeared in the best of spirits.

The next morning we went out and ascended a slight eminence, called *La Calvarie*, from which there is an excellent view of the old town, which is picturesquely situated in the valley of the Moselle, the hill sides being clothed with vineyards. We also visited the old church, and were able, in spite of the frequent showers, to walk a good deal without getting wet, as the pavement is generally under cover of the projecting houses. We called on the director's mother, who has a nice house with a good garden, very well stocked with fruit and flowers; the rhododendrons were just coming into bloom, and a large number planted in one block had a good effect. We then took our places in the *coupé* of the *diligence*, and drove to Faymont through undulating fir forests. Here we dined in a very primitive little inn. The meal was sumptuous, endless courses succeeding each other, but the arrangements were somewhat rough, and the carving or rather hacking of the joints was remarkable. After dinner we left by train for Vesoul, where there was a very good hotel with spacious apartments. In all the hotels in the Vosges we found the landladies delightful, so

obliging and anxious to make everyone comfortable; but not one of the hotels seems to possess a bath, and we were very glad we had brought an india rubber one.

Every morning we were roused by the sound of the *cor de chasse* under our windows; it was sounded again for our meals and to warn us when to start for the various excursions into the forests. In primitive little villages it created quite a sensation, all the inhabitants gathering round Masseron to watch while he played. It was again very wet, but the students went to visit a very fast growing forest, where the oaks add about one centimetre per annum to their diameter. We had dinner in a kind of coach house, and then went by train to Gray; we rose early and explored the curious old town, part of which is built on a high plateau reached by flights of steps from below, on the higher level is situated the church and an old unoccupied chateau, into the grounds of which we penetrated, and from a walled terrace had a very pretty view of the river below. There were some rather good shops and some barracks, in front of which a circus was being erected. The dragoons were lounging about; they looked most slovenly with their loose ill-fitting tunics and trowsers, and are a great contrast to the smart English cavalry soldier. We entered the church where service was going on, but we did not like to attempt the ascent of the tower, whence no doubt we should have had a splendid view. We strolled into a shady garden, where the nightingales were singing sweetly. There is a fine suspension bridge at Gray, and the town is very old and quaint, the buildings being remarkable for their steep pent roofs.

In the afternoon we took the train to Arbois, and this brought us into the Jura mountains, which present a different appearance from the Vosges, in that instead of the tops of the hills being rounded they terminate in abrupt cliffs. Another remarkable feature of these mountains is that many of the streams rise in a considerable volume, which one would suppose to be the result of a course of several miles. Another contrast between the Vosges and the Jura is, that the latter have not been taken in hand by the Club Alpin Français, and therefore the Cockney appearance given by the numerous notice boards is absent. Our bad luck with the weather still pursued us. Torrents of rain spoilt all excursions, and our limited stay of one night in each place did not suffice to dry our dripping garments. The champagne at Arbois is rather sweet but very good. After the mid-day meal we drove across country to meet the Pontarlier train. The road was pretty, passing among the silver fir and spruce trees, and it ascended considerably before we reached the mountain railway. The clouds had been heavy and threatening all the way, and the storm burst just as we reached the station. The train was very crowded, and in our carriage were five Americans travelling

for amusement, but encountering considerable difficulties, as not one of the party could speak a word of anything but English (American). We tried to help them a little, but we soon had to part company, as they were going on, while we remained for an hour at Andelot, where we had dinner in the railway *restaurant*. Our company was not very select, for there were some workmen at another table who were rather merry over their wine and indulged in songs until stopped by the waiter. We then continued our railway journey to Champagnole, which we reached about 9 p.m.

The next day broke with torrents of rain and we relinguished the idea of walking through the forests to Andelot, where we were to have spent the night, for we heard such accounts regarding the limited acommodation available, that out of kindness to the rest of our large party we decided to go on to Dijon, which place they were to reach on the morrow. The rain cleared off after a time, and we took a walk and gathered a bouquet of the lovely wild flowers with which the Jura mountains abound. There are beautiful wild carnations, hyacinths and pansies, all sweet-scented, and the meadows are covered with the pretty pink feathery grass we had found in the Vosges. Certainly the wild flowers of the Jura mountains surpass anything we had previously seen for variety, beauty and abundance. The Alps are not to compare with the Jura in this respect, though the alpine flora is much admired. We walked on and got a good view of the range with its characteristic sharp-pointed rocks. We left Champagnole in the afternoon and reached Dijon that night. The day following we visited the botanical gardens, where there is a wonderful poplar tree remarkable for its great height and girth. There is also a natural history museum containing a variety of stuffed birds and animals. We also visited the Cathedral (St. Benigne) and the old desecrated Church of St. Philibert, also the Cathedral of St. Jean, which has been restored, and the ruins of the old castle, which has now been converted into a barrack. After breakfast we went to see some ancient houses in the *Rue des Forges*. Then we visited the Hotel de Ville, where there is a good museum containing some paintings and the monuments of the Dukes of Burgundy; in a glass case there are 36 decorations worn by the late Marshal Valliant. Every country seemed to have joined to decorate this much favoured individual, including England, which conferred a G. C. B. on him. We next ascended 314 steps to the top of the tower, which commanded a fine view of the surrounding country with its hills and forests. Here again the vineyards which produce the excellent wine of the country met the eye in all directions. Notre Dame was the next object of interest. It has a fine carved facade and a curious old clock, the hours being struck by hammer-men. Then we drove to the park, about a

mile-and-a-half from the town; this is simply a wood with drives and walks cut through it.

The roses in Dijon were very beautiful, but we looked in vain for the famous *Gloire de Dijon*, and could only conclude that perhaps it was not yet out. In the centre of the town is the Place d'Arcy, very prettily arranged with rose gardens and a fountain, in a small sheet of water, on which floated two stately swans. Dijon is just at the commencement of the sunny south; the air was warm and balmy, a pleasant change after the cold and wet we had just experienced in the mountain ranges. The next morning we paid another visit to the botanical gardens, and saw also the Well of Moses, with some fine old stone carving depicting scenes in the life of the patriarch. This is at the Old Chartreuse, which is now an asylum for idiots. We then invested in some photographs, including the pretty pathetic ones of girls in the national costume of Alsace and Lorraine, now, alas! no longer French. After this the entire party started by train for Nancy which we reached that evening, and thus ended a pleasant tour in the Vosges and Jura mountains, the inspection of whose noble forests doubtless proved very profitable from a professional point of view.

BENEFICIAL RESULTS OF THE SAU TREE ON THE GROWTH OF TEA.

DEAR MR. EDITOR,—Amongst your interesting notes collected during your peregrinations through Assam and elsewhere, you make a reference to the beneficial results of the sau (*Albizzia stipulata*) tree on the growth of tea. This subject only very recently excited a deal of attention, and was the sole topic of conversation in our "one-hobby" province. It was taken up earnestly by Mr. Buckingham of Sibságar, who drew particular attention to it, through a pamphlet he had printed and circulated by the Indian Tea Association (I think), in which the opinions of various Managers of Tea estates were recorded. The advocates of sau cultivation claim for it, that its effects are a more vigorous growth, and consequently a greater yield from all tea bushes shaded and protected by it; some, on the sole ground of visual observation without other reason, others, and they the majority, contending that the roots enrich or impart certain chemical properties to the soil beneficial to tea, the shade afforded being also a favorable factor. I happened to be in charge of a tea district when this subject was the nine days' wonder, and though my scope for observation was limited, not for lack of tea gardens, but sau trees, the opinion which I modestly put forth, not pretending to infallibility, may be useful if only to cause refutation.

Most tea gardens are without shelter of any description, and

the occasional tree found amongst tea, is more often the result of accident than design. The tea bushes are, therefore, at the mercy of the weather; a continuation of hot winds, an extra long spell of hot blazing sunshine, or a succession of wet days with cold winds, all affect the bushes to some extent, causing blight, burning up or hardening of tender shoots and leaves, &c. The casual observer would call for shade at once, but the experienced planter knows that the dense cover which most Assam trees possess, mean death to his bushes, and that the roots of others, like rubber (*Ficus elastica*), bhola, &c., are equally injurious. The happy mean was not sought for, till nature herself manifested what it is now asserted to be. Who claims the honor of reading nature in this aspect first, I do not know, but in the Mangaldai sub-division of Darrang, the influence of the koroi (*Albizzia procera*) had been discussed and acknowledged long before the "sau" excitement. This particular sub-division presents, with a few mediocre exceptions, very poor specimens of tea gardens, and the marked difference between bushes shaded or not by koroi, was thus very striking. The tree has superficial roots, very small leaves, bears seed copiously and at an early age, and seems to spring up spontaneously wherever a clearance has been made, provided it is not in absolutely grass jungle. This is the case all over the Mangaldai sub-division and other parts of Darrang, also in Nowgong near the Sibságar boundary, and south of Deboka to the North Cachar Hills. It usually commences on the outskirts of bits of evergreen forest, which are surrounded by grass jungle, or amongst mere saplings, generally of inferior kinds of timber like akshi (*Dillenia pentagyna*), bhola, two species of Eugenias, and amlukhi (*Phyllanthus Emblica*), in which case there is almost certain to have been a former clearance, either for cultivation or charcoal burning; and is also found in the numerous little islands embedded in the larger streams, and on the banks of rivers, where the land is subject to occasional inundation. But it must be remarked that in almost all of these cases the land is considered too low to be very favorable to tea culture. Koroi trees also grow on the higher lands, but not to the same extent, and some of the clearances above referred to are abandoned tea gardens. My experience of the sau tree is somewhat similar, though it is not met with as frequently as koroi. It is not found to any great extent on higher lands, but is common in the Charduar plantation, which is low and subject to inundation, at odd and frequent periods during the rains. The leaves of the sau tree are smaller again than those of the koroi. Both trees grow fairly rapidly when young, presenting a lank, ill-conditioned appearance, but the process of growth is much slower as they approach maturity.

I should have premised by stating that my experience only

extends over two tea districts, and that their peculiar characteristics are what are depicted here, but I suppose there cannot be much difference elsewhere. I have seen tea bushes growing under both the sau and koroi trees, and have been much struck by their luxuriance in comparison with adjacent bushes, and have considered these trees the panacea for all tea woes. But a "change has come o'er the spirit of my dream," and no longer have I implicit faith in koroi and sau trees. Roaming promiscuously over two different tea gardens 60 miles apart, I found tea growing under koroi trees of great growth, and lo! the tea bushes under their shade were, if anything, inferior to those beyond it! A change of quarters immediately afterwards to where tea is not grown, has deprived me of opportunities for further observation, but it would be well worth the attention of well-informed observant men like Mr. Peal, to trace this further. My own experience therefore leads me to the belief, that no advantageous chemical properties are imparted to the soil by either the sau or koroi, and that it is only the shade afforded by them which is beneficial, and that only whilst they are young, for once they attain maturity and a great size, the shade, slight as it may be, becomes too dense, and the prolongation of the surface roots becomes inimical. All the evidence obtained hitherto, as far as I can learn, in favor of the sau or koroi, rests upon those trees seen when immature and of small size.

11th July, 1885. "ASSAM."

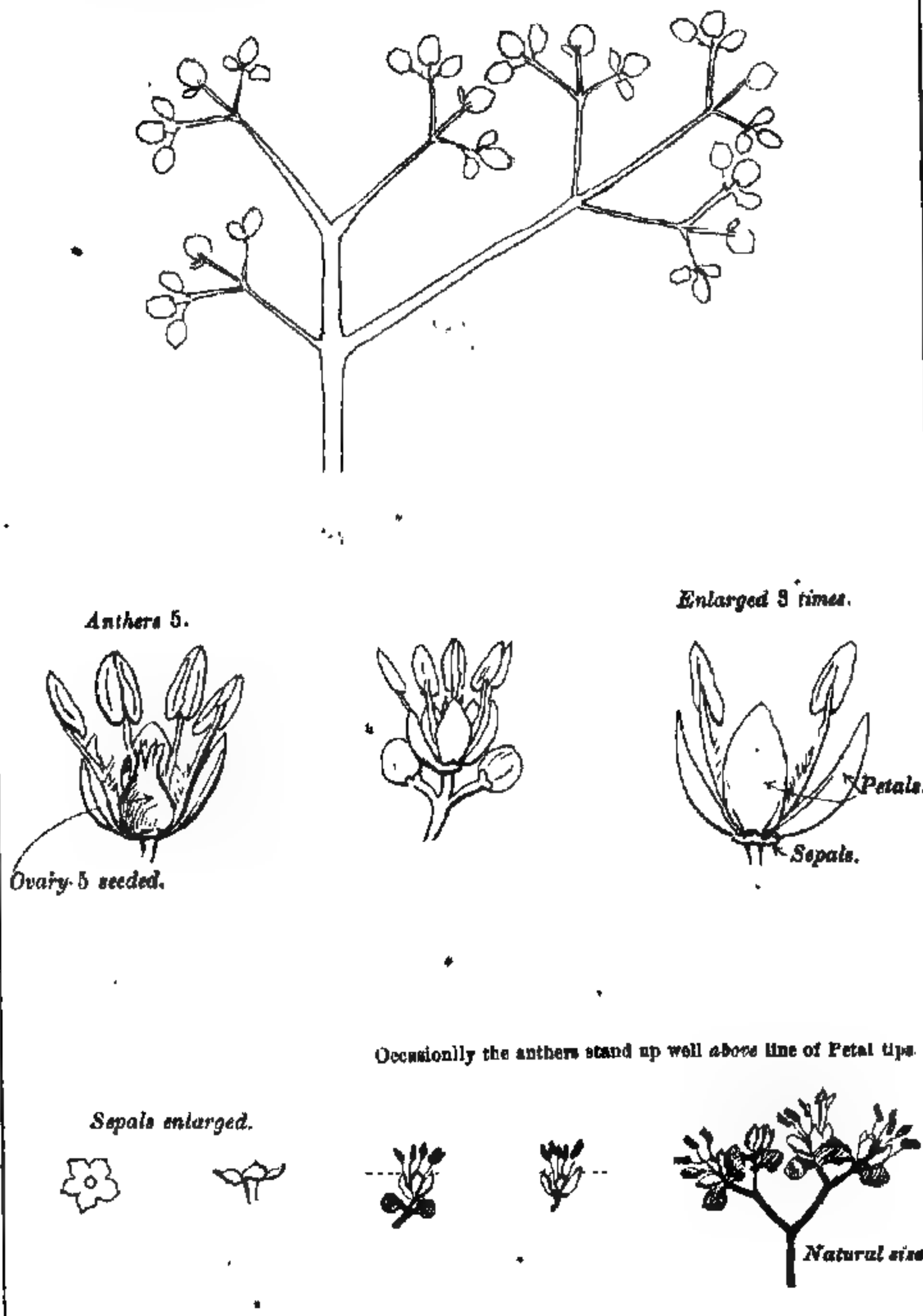
SEEDS FROM CAPE COLONY.

We have received seeds of some South African trees from Mr. Hutchins, and have distributed them to the forest and botanic gardens at Ranikhet, Landour, Mussoorie, Chakrata, Simla, Ootacamund, and hope to hear of their successful germination, and of the future progress of the plants. The species sent are Sneezewood (*Pteroxylon utile*), Yellowwood (*Podocarpus elongatus*) and upright Yellowwood (*Podocarpus latifolius*).

COLONEL MICHAEL'S METHOD OF CUTTING WOODS FOR EXHIBITION.

In Col. Michael's Report on the Indian Section of the Edinburgh Exhibition of 1881, he says "the woods were cut here after a pattern which I introduced some years ago in Madras, and which was adopted there as a standard. This method of cutting woods for exhibition or museums was greatly approved by foresters here, and by the jury, who awarded me a special diploma for it, and it has figured in the *Gardener's Chronicle* of the 2nd August."

INFLORESCENCE OF THE MAIPHAK.



S. E. Peal.

Litho. T. C. Press, Roorkee.

Thos. D. Bona, Supdt.

Now that there is such a rage for collecting specimens, I am sure many would be glad to learn something more about this "pattern."

H. S.

THE MAIPHAK.*

Mr. S. E. Peal writes as follows from Sibságar, Assam:—I have been watching the Maiphak for weeks, it is in bud, and I will send flowers, when out in a few days, to you and Mr. Gamble. One that I found open I dissected; the calyx 5-lobed as in *Plate* (very small), petals 5, inserted just above, and in between the sepals, filaments 5, arise between and at base of petals, just above, filaments hairy, the ovary pear-shaped, apex cleft into 5 pistils.

The whole top of tree is covered with buds.

THE KADDAM FOR TEA BOXES.

Mr. Peal also writes—I am planting out Roghu here (*A. Cadamba*), and expect it will be fit to saw up in 8 to 9 years. Some were planted in June 1884, and now say 18 months old, are 24 feet high, and 12 and 14 inches girth. From what I see I think one inch per annum *radius* can be relied on for the first eight years, after which it gets slower and slower, down to quarter inch at 16 years. The plants are got from my tea nurseries, and no one so far can raise Roghu from *seeds*, but thousands sprout in all clearings.†

* Botanical specimens collected by Mr. Peal have now been sent to Kew for determination.

† There is also a difficulty about ensuring germination of the Huldu (*Adina cordifolia*), a plant allied to the Roghu or Kaddam, but we have succeeded in raising seedlings of the latter, in raised beds of fine charcoal dust, in the same way as *Ficus elastica* is sown in the Charduar plantation in Assam.—[Ed.]

III. Notes, Queries and Extracts.

Forest Administration in the Thana District.—The following resolution, dated the 20th of July, has been issued by the Bombay Government, on a letter from the Acting Collector of Thana, bringing to the notice of Government some points connected with the forest administration of the district on which it has been found impossible to carry out the orders of Government fully; making some suggestions for the improvement of the system of supplying wood and other forest produce to the residents of the district; and forwarding correspondence between himself and the Divisional Forest Officers, Northern and Southern Thana on the subject:—

These reports explain what was before not quite intelligible to Government, *viz.*, why the settlements of forest questions sanctioned in a series of Resolutions ranging from that on the Thana Forest Conference issued in May 1883, to that on the Callian Taluka Forest Settlement published last May, should have had no effect in adjusting administrative difficulties. It now appears that great delay has occurred in accurately demarcating and making known to the people the forest areas and the precise nature of the privileges accorded by Government. Until this is done and the orders and regulations applicable locally are fully understood, there must be confusion and uncertainty. The delay which has happened is much to be regretted, and all the responsible officers should be stimulated to use the utmost possible despatch in carrying out the instructions of Government and making the people concerned acquainted with those orders.

The series of resolutions above referred to, and the reports of the Thana Forest Conferences show that in that district great difficulties have beset the enforcement of measures of forest conservancy owing to neglect of orders in previous years. Abuses had become so habitual that it was impossible to proceed other than tentatively, by trying various expedients for supplying wants in a legitimate instead of an illicit way. Some of these experiments have succeeded, others have failed. Government has not insisted on hard-and-fast lines, and has been ready to modify and relax their measures on sufficient cause being shown, with the result that there is little to change in or add to the latest orders on a forest settlement (that of the Kalyan Taluka) in order to remove the administrative difficulties explained by Mr. Loch. In a question of so much difficulty and obscurity it is impossible to select at once the best and most ap-

propriate measures: they must be gradually arrived at by experiment and observation. But the objects which the Governor in Council has in view are—1*st*, that the Government regulations in respect of forests, as finally settled should, whilst preserving the public interests, be equitable and liberal in dealing with private interests, and, 2*nd*, that these regulations when finally settled should be firmly enforced.

With regard to Mr. Loch's first proposal, as noted below, the Governor in Council observes that there must be confusion in carrying out regulations whilst everything is shifting. Until forest areas are finally settled and demarcated—a work which should be completed as speedily as possible—the executive officers must make the best arrangements feasible, only taking care, not to resort to extreme measures against trespassers who may transgress orders in ignorance. Government concur with the Commissioner in considering it undesirable to adopt Mr. Loch's suggestion that in the unsettled talukas and the talukas where settlements have been sanctioned but not yet applied "the cultivators should be allowed to cut materials for ráb in the village gurcharans in the old way," which would involve a return to disorder and confusion. Nor is there any real need for the adoption of so retrograde a measure. In their Resolution on the Kalyan settlement Government have authorized the lopping of *ain*, *dhavda* and *bouda* trees in the protected forest areas of the settled talukas. To these there may now be added *nana*. These four varieties of trees are those most used and most useful for ráb purposes, and the permission accorded to lop them in the protected forest lands will, as stated by the Commissioner, reduce to a minimum the ráb difficulty. Where settlements though sanctioned have not yet been introduced, pains should be taken to make the orders generally known, and the people will then have no reason to transgress them as their wants will be amply supplied.

It is necessary now formally to notify under Clause (a) of Section 29 of the Indian Forest Act, the trees to be reserved in protected forests in each taluka of which the settlement has been made. The Forest Settlement Officer, Mr. Atkins, should be requested to submit at once, in consultation with the Collector and the Divisional Forest Officers, a list for each taluka of the varieties of trees proposed to be reserved in the protected forest of that taluka.

The proposed reduction in the prices of timber and other forest produce, including bamboos, is sanctioned as a temporary measure, but the benefit of the reduced rates need not be allowed to wood-dealers or purchasers for export.

The Governor in Council approves of Mr. Loch's proposal that "steps should be taken to close against the traders those forests where the supply of dead wood is only sufficient for the wants of the local community," as also of the suggestion that fellings should be substituted for depôts. It has been made

quite clear in what manner and to what extent Government desire that the wants of the people for agricultural implements and building materials should be supplied, and the local Land Revenue and Forest officers should take the requisite action to carry out the wishes of Government. It is the special duty of the officers in charge of talukas and of the Collector to bring shortcomings in the supply to notice.

The wild tribes are already permitted to obtain from the forests free of charge such wood of the ordinary sorts as they need for the construction and repair of their dwellings, and no further orders on the subject are needed.

Nor does it seem necessary here to issue any additional instructions on the question of grazing and grass-cutting in the Government forests. The orders of Government on this point are explicit and liberal, and the Commissioner does not press for any modification of them. Inhabitants of non-forest villages must pay for grazing, but the fees charged should be very low at first.

Government entirely agree in the views expressed by Mr. Loch in paragraph 14 of his letter, which are in accordance with the orders already issued by them in the Resolutions No. 2638, dated March 27th, 1884, and No. 4120, dated May 21st, 1885.

BOMBAY FOREST COMMISSION.—His Excellency the Governor of Bombay opened the Forest Commission at Poona on Thursday, and in a long speech held that local wants, local customs, and local systems of tenure should not be disturbed unless good cause could be shown for it, and promised that wherever free grazing had been enjoyed a full equivalent would be given. Lord Reay, addressing the members of the Commission, said :—

You have a very delicate and difficult task to perform. You will, I am sure, acquit yourselves of the trust reposed in you with complete independence. The value of your labours will be enhanced if you lay down in your Report the conclusions to which you may have been led by the inquiry, however varied they may be. It is, perhaps, not superfluous for me to add that the members of the Commission who represent the Civil Service are not acting in any way on the Commission as delegates or representatives of Government, but have been appointed to give their own views, the results of their own experience. You will, on the other hand, have to deal not with individual actions or the opinions of individual Government officers, but with the effect of resolutions for which Government is all-responsible. As long as the actions of a Government officer are sanctioned by the open or tacit approval of Government, Government is responsible. I need not here enter elaborately on the various causes which have led to the appointment of this Commission, but it is a remarkable fact that both the late and present Secretary of State have approved of the institution of this inquiry,

and the sanction of His Excellency the Viceroy has also been obtained. The importance of the subject has been recognised, therefore, on all sides. Since I have had the honour of being charged with my present duties the matter has been a constant source of anxiety to me. Agricultural problems have always struck me as peculiarly interesting, and the more one looks into the various agricultural systems of various countries the more one becomes convinced that over-legislation in agricultural matters is a mistake, and that in the present condition of agricultural science, which is not by any means as far advanced as it ought to be, we must be careful to interfere as little as possible. Agricultural centralisation would certainly lead to disastrous consequences. To introduce into Lancashire the agricultural system of the lowlands of Scotland or the Ulster custom would betray rashness. Local wants, local customs, and local systems of village tenure have a right not to be wantonly disturbed unless a very good cause be shown for it. In many instances a scientific justification for local agricultural practices unconscientiously observed by the population will be forthcoming. I approach agricultural questions with a strong bias in favour of the agriculturist, as every Scotsman would who has been accustomed in Scotland to give the most respectful consideration to the experience of shrewd farmers and shepherds and farm servants. In his speech on the Indian Budget the Secretary of State asked the question, how are you on the one hand to obtain the most desirable objects of preserving and renewing the forests without, on the other hand, entailing hardships on the people by depriving them of valuable and long-established rights? That is the question which has constantly presented itself to me. I believe, however, that if forest conservancy tends to increase the supply of fodder and fuel for the people of this country, the enterprise will meet with their support and has a right to their sympathy. I also believe that the hardships can be mitigated, and that we have recently done a great deal to reduce them to a minimum. My chief object is to substitute co-operation for antagonism, confidence for distrust, contentment for disturbance. The worst result of centralisation is that measures which must inevitably benefit the people ultimately take a longer time for their acceptance than if they had been settled locally. In every forest settlement which I have dealt with I have always carefully considered the peculiar circumstances of the locality, the existing resources for feeding of cattle and for the extension of cultivation, and the advantages which would accrue to the inhabitants from forest conservancy. And here, gentlemen, let me say that I believe that if your district boards had to deal with these questions they would not in their decisions come to conclusions differing very materially from those to which we have come. We are at great disadvantage because we have very often to decide at a distance intricate questions, and I for one have very keenly felt the respon-

sibility of deciding between conflicting opinions of local officers who performed their difficult duties with great care. One thing, however, is quite clear. If you wish to have improved fodder and more fuel you must allow your plantations to grow; you must protect the young growth by closing such areas; you must close those areas in such a way that you cause a minimum of inconvenience to those who used to find on such areas pasture for their cattle. On the grazing question your report will no doubt throw light, but meanwhile you may take for granted that it is the determination of Government that wherever free grazing has been lawfully enjoyed it will be continued by giving a full equivalent in all those cases where the area hitherto used has been absorbed. I do not think that the people will have anything to complain of, as the equivalent will be an improvement on what formerly provided them with an insufficient supply. How, when, and where areas are to be closed; how, when, and in what numbers cattle are to be admitted to open areas, and on what conditions, seem to me to be essentially questions which must be settled on the spot by the combined action of the Revenue officers and the Forest officers, and on which Government can only lay down general principles. I may give an illustration from my own personal experience. By the last mail I instructed my agent, who had asked me whether I wanted pasture or timber, to settle the matter on the spot. Your Commission will fulfil the mandate contained in the Government resolution of July 24th unhampered by any extraneous influence. A speedy, full, and local investigation of the forest conservancy of the district of Tanna will, however, be most welcome to the Government, as it wishes to obtain your advice in detail on the situation of that district which affords scope for the examination of nearly all the questions with which Government have to deal. You will, I doubt not, assist the Government in its endeavours to remove legitimate grievances. You will also assist Government in preventing wanton destruction of timber, a proceeding utterly unwarrantable and most demoralising and injurious to the local national interests. A strong Government does not stand in need of exceptional measures to put a stop to such vandalism. This Commission will strengthen, not weaken, the ultimate actions of Government. It will uphold law and order, promote one of the chief elements of agriculture, namely, good pasture; promote harmony between the Administration on the one side and the people on the other, whose interests will be ably represented on this Commission, not only by those whom they will perhaps more especially consider as their representatives, but also by officials whose desire, I know from personal experience, it is to preserve to the people privileges to which naturally they attach great value. You enjoy the confidence of Government, but your labours, gentlemen, will, I am sure, give you a further title to the gratitude of the people of the Presidency.

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ON THE WORKING OF THE FORESTS IN BAHRAICH AND THE BORDERING NEPALESE DISTRICTS IN ITS RELATION TO QUESTIONS OF CONTROL.

Introduction.—The proper control of the Government forests in Bahraich is complicated by a number of special circumstances, which again re-act on the revenues. It will be the business of this article to describe what these special circumstances are, and to suggest corresponding remedial measures. It occurred to me that, while occupied on such a very instructive and wide-ranging subject, I would do well to amplify it so as to embrace a very detailed account of all those methods by means of which we endeavour, in this part of India, to place a check on the illicit removal of material from our forests.

Much of this will necessarily appear superfluous to the readers; but others—notably in localities where protection is difficult, or has but just commenced—should take an interest in this part of my subject. This, and the conviction that, apart from the bulk of my article, I have treated throughout on a number of instructive questions, is my apology for the length to which I have permitted myself to run.

Extent and importance of the Nepal forests subtending the Bahraich district.—The Nepal forests extend all along our frontier in Bahraich, occupying most of that very considerable territory which was given by us to the Nepalese some thirty years ago for their assistance during the trying times of the Mutiny, and which is popularly known as the "Nepal Terai." The hills and valleys beyond this again, like our own hills and valleys similarly situated in Garhwál and Kumaon, are rich in forests of every description, while the great Rapti valley has acquired, in this respect, a wide-reaching fame. These forests are, therefore, of enormous area, and the forests of the Terai alone have always borne the reputation of being the finest sál forests in all India. They may be said to be inexhaustible.

The causes which tend to make purchasers go in preference

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to Nepal for their timber and other forest produce.—There are very many reasons why purchasers should, as a rule, and when in a position to do so, prefer going to Nepal for their supplies of timber and other forest produce. In the first place, they can obtain in Nepal a better article at a lesser cost. We cannot compete with Nepal. A mere reduction of rates on our part would be immediately followed by the same step being taken on the part of the officials across the border. With their inexhaustible resources, and with no expense in the way of an organized forest establishment to provide for, no forest improvements to pay for, these latter can, of course, afford to reduce their rates below what would amount to absolute ruin in our own case. Then we do not possess the fine quality of timber that is found in Nepal. In fact, we have got in Bahraich comparatively very little sound mature sál timber at all.

On the other hand, the quantity of dry and inferior sál is so great everywhere—even in our own forests—and the rates for this are necessarily so very reasonable, that other species of trees—and we have remarkably fine "asna" (*Terminalia tomentosa*) and "tikwee" (*Adina cordifolia*) trees—find almost no sale at all.

The Nepalese, it is true, export very considerable quantities of "asna" and "asidh" (*Lagerstrœmia parviflora*) poles, but at prices which we should deem ruinous to the seller. The Nepal forests being but continuations of our Bahraich forests—themselves but a narrow fringe along the frontier—in a northerly direction, there is nothing to choose between the two in regard to distance, not at least so far as the timber merchant is concerned. The whole southern border of the Nepal forests is sapped by numerous roads constructed by ourselves within the Government forests, while two excellent rivers communicate with the far interior. Although, therefore, not so accessible as our own forests, the advantages possessed in this respect by the forests of Nepal are of no mean order. Water again is better and much more plentiful than with us.

Once arrived in Nepal, the dealer has no long search to make before finding what he is after. His movements and actions are in no way interfered with, as among ourselves, by necessities of control and conservancy. He is not afraid of firing the forest. In fact, he will certainly do so if he can thereby derive any additional comfort or advantage. He can cut almost where he pleases and what he pleases, neither is he restricted as to time. He knows pretty well what his logs should cost him, and with tact and resource he can hope to do a good deal occasionally without at all having to disburse in the same proportion.

Nature of the purchaser's objections in respect of our Government system of control in Bahraich.—The nature of the purchaser's objections in respect of the method of control followed in the

Government forests of Bahraich can be summarized in accordance with his own notions on the subject. Of course, many of the inconveniences complained of by him are inseparable from an efficient system of control as opposed to the total absence of these conditions in Nepal. Still, I think that some of the delays incurred by purchasers in our forests are capable of being rendered somewhat less serious, and that a few other inconveniences could perhaps be mitigated, if not removed. If they exist at all, the fault is not, as a rule, a departmental one. Any great improvements in the existing system mean an increase of establishment, and this increase we have hitherto appealed for in vain.

(*a*). He has to dance attendance on some official until he has succeeded in getting the preliminary permit supplied to him, and the trees selected by him approved of and marked.

(*b*). He may have to remove his logs out of the forest before the advent of the fire conservancy season, under pain of having to abandon them to the following winter.

(*c*). He has to collect the material in some stipulated locality for the purpose of having it measured up and passed, previous to his paying the balance on the same and being finally permitted to cart it away.

(*d*). He has to dance attendance once more on some forest official until this latter person finds himself possessed of the leisure to measure up the material in question, in consequence of which the purchaser is always subjected to more or less grievous delay, losing his time, and obliged to pay more in transport than would have been necessary if we had, like the Nepalese, a system of fixed revenue stations with officials always present to measure up and pass timber at the moment of its arrival.

(*e*). He has the strongest objection to our tariff system, which places him at a great disadvantage in his struggle over payments with the Ranger. The cubic foot is incomprehensible to him as the basis of our calculations. Unable himself to determine the capacity of his log, he surrenders himself a helpless, but thoroughly discontented person—in his opinion, victim—to the generosity of our Ranger. He can very well understand having to pay a fixed price for logs belonging to the same class as determined by well-known limits of length and of girth; this he is intelligent enough to grasp; and, moreover, he is able to learn a simple tariff of this kind by heart, and capable of not paying more than he knows to be written down in such a tariff. But

how should he know any thing about volumes? Do you expect the illiterate dealer to go about with a translation of Hoppus's Tables in his "kummerband?" Surely we should put a stop to this absurd tariff system of ours! of itself, it is enough to drive away all our native customers.

Classes of timber and other produce that are passed into Bahraich from Nepal.—The timber and other forest material that is passed into the Bahraich district from Nepal can be classified as follows:—

(*a*). Logs of green mature sál, generally of very fine quality and dimensions.

(*b*). Dry sál timber of all dimensions, converted and unconverted. The converted timber is confined to props, posts, rafters, canoes, &c., &c., all fashioned out of hollow sál trees.

(*c*). Poles of asna and asidh (*Terminalia tomentosa* and *Lagerstrœmia parviflora*). These poles are generally very fine ones, being often of 50 feet in length with a mean girth rising up to $3\frac{1}{2}$ feet.

(*d*). Kutch, hides, wax and honey, canes, bunkus-grass (bhábar), múnj grass, reeds, &c., &c.

Lines of transit followed by the Nepal timber merchants.—The whole of this export from Nepal passes into the Bahraich district in two different ways:—

(*a*). By means of the river Rapti, and the rivers Koriala and Girwa (which further down in their course unite to form the great Gogra).

(*b*). By means of numerous roads in communication with the Nepal frontier, and which, after traversing the Government forests, finally abut on to the above two rivers.

In regard to these two main lines of transit, it is necessary not to lose sight of the fact that, while both of the rivers mentioned above flow through our Government forests immediately after leaving Nepal, so also most of the roads in question are departmental roads constructed within the limits of the Bahraich State reserves. In other words, almost all this import from Nepal finds an issue into British territory by way of our Government forests.

Final destination of the timber and other forest produce from Nepal.—The whole of the superior Nepal timber is taken down the rivers Gogra and Rapti to Byramghát, Fyzabad, Gorakhpore, Dinapore, &c., &c. The inferior stuff is, in great part, consumed within the district itself, as also a certain quantity of minor produce, principally reeds and grasses. Latterly, much "bunkus" grass (bhábar grass) has found its way to the paper mills in Lucknow. The kutch, hides, honey, &c., &c., find a ready market in the larger towns of the province. I have seen

no bamboos imported from Nepal, although the lower hills of that country should be as rich in this commodity as the similarly situated hills in Kumaon and Garhwál. The incontested fact of the presence of elephants in the Nepal Terai should, of itself, be sufficient evidence of the existence of bamboos.

The Nepalese system of forest control.—I shall now describe in general terms the Nepalese system of control, as applied by them to their forests. Being founded in great degree on the assumed integrity of a host of very underpaid officials—in which it has some points of resemblance with our own—this system would be considered as open to several objections on the part of any proprietor who should not think himself satisfied with a moiety only of his revenues.

The timber and other forest produce collected by purchasers in Nepal has to pass out of that country by some one or other of a numerous system of frontier revenue stations. These latter are conveniently situated for the purpose on the banks of important rivers, at the only points of egress from enclosed valleys, and along the more important roads leading to the frontier. The paucity of these roads and the nature of the country renders it difficult to evade this obligation. Besides which, the punishments in Nepal for misconduct are on rather a barbarous scale, and persons who have not behaved themselves well enter the country again at considerable personal risk. These frontier revenue stations, or "chaukies," are of two classes, the major and the inferior chaukies. In the richer timber districts the former alone exist, or are supplemented by but a few inferior chaukies. All purchasers in quest of sál logs, and superior timber generally, have to make their applications at the larger stations, each of which is presided over by a superior official of the rank of a "Lieutenant-Sahib." But purchasers requiring any other form of timber; anything, in fact, but sál logs, are not necessarily subject to this rule. For such purchasers, permits can be obtained at the smaller chaukies dotted along the frontier.

In either case the purchaser is obliged to provide himself with a permit before he is permitted to commence operations within the forest. In this respect the Nepalese system of control does not vary from our own. And in the same way the purchaser has to pay an instalment in advance, and when his material has been got ready for export, he is also under the obligation of having it measured up and passed at the station or post whence he originally procured his permit.

After having here paid the balance due on his purchase, after deduction of the instalment already referred to, he is permitted to depart from the country. But if his purchase should include superior sál logs, the latter have, as a final measure, to be stamped with the Nepalese timber sale-marks. I shall refer to these further on. In return for his money, the purchaser obtains

a written pass, in which are entered particulars in connection with his purchase. The amount paid is most generally omitted. These Nepalese timber passes are impressed with the seal of the issuing revenue station.

If we consider the Nepalese system of timber control from the point of view of the obstacles which it presents to thefts from without, then is this system almost perfect. On the other hand, if we look at it from the no less important aspect of the hold which it should exercise over the revenues realized by the forest officials, we come perforce to the conclusion that no such control even exists. At the superior stations the "Lieutenant Sahib," and at the smaller posts the Mohurrir, can do pretty well what they like with their forest revenues, so long as they do not go beyond certain limits, so long as they can depend on the loyalty of a jealous, and perhaps a hostile entourage. They have, it is true, to remit the revenues realized by them periodically to the district treasury. But accounts, in our sense of the word, are unknown, or are only submitted after lengthy intervals of time—say one or two years.

Peculation within certain undefined limits is, therefore, tolerated.

Names and situation of the Nepalese revenue stations off the Bahraich forests.—It may be useful here to mention the names and the situation of all the Nepalese timber chaukies that are situated off the Bahraich Government forests. They are as follows :—

Name of Forest.	*Main Chaukie.*	*Subordinate Chaukie.*
Burthapur, ...	Dhanowra (river station), ... Chowbarsi („ „), ...	... ...
Motipur, ...	Dhanowra („ „), Bachhi („ „),	Taratál.
Chakia, ...	Jumni, ... Báki, ...	... ...
Bhinga, ...	Bhagwanpur (river station), ...	...
Sohelwa, ...	...	Khairbatti. Markátwa. Ajgarwa. Mandowra. Bhowa. Bhainsahi. Sonpathri.

The Nepalese forests opposite Sohelwa, and which are not tapped by the Rapti river, of which the great frontier revenue station is Bhagwanpur, include only a range of very steep and barren hills. It follows that only inferior material and minor

produce is imported into British territory in that direction, and this accounts for the absence of any important revenue post.

On the other hand, the configuration of the ground is such that, divided up as it is into a number of confined ravines and valleys—almost all of them mere *culs de sac*—each of these latter is bound to have its own independent chaukie, if there is to be any control at all; hence the great number of these smaller revenue posts in Sohelwa.

Nepalese timber marks.—The Nepalese regard any thing below a sál log (of say 5 feet in mean girth) as being too unimportant to stamp with their sale-marks. It is true that the Nepal Darbár, in a communication of its orders on the subject to the British Government, points out that every thing exported from the Nepal forests, and susceptible of receiving a sale-mark, should be so marked; but the orders of the Supreme Government do not appear to be, in this respect, at all attended to.

The timber marks of the Nepalese are very peculiar. Upon each log passed through one of their main depôts—supposing that the log in question is important enough for the purpose—the following sale-marks have to be impressed in the Hindi character:—

1. The first letter of the word "Bikri," or sale.
2. " " " " "Dwár," or depôt.
3. " " " depôt itself.
4. " " " word "Lambaee," or length.
5. " " " " "Motaee," or girth.
6. Figures denoting the length.
7. " " " girth.

From the above you will be able to gather some of the reasons why the Nepalese should be rather frugal of their marks, and should object to applying them to other than very valuable pieces of timber. Think of the waste of time! A really properly marked Nepalese log—I have seen very few of them, however—resembles nothing less than an Egyptian monument of ancient date.

Nepalese timber passes.—The Nepalese timber passes are in manuscript, in the Parbuttia language, and bear the impress of the chaukie which issued them. There could be no objection to these passes if there was only some control over the persons issuing them. It is not pleasant to think that, for a small consideration, the mohurrir at a neighbouring Nepalese chaukie—an underpaid official, and therefore presumably not tickled with an excess of pride—might take it into his head to add a little to his income by manufacturing passes—perfectly genuine passes too—for evilly disposed persons, who could then make use of these passes to export stolen material from our own forests. It is also a grievous drawback that, these passes being drawn up in the Parbuttia language, none of our officials can make anything of them.

Our interest in keeping a watchful control over imports into Bahraich of timber and other forest produce from Nepal.—From all that has preceded it will be understood why it is that the Forest officer in Bahraich has to exercise so much supervision over imports of timber and other forest produce from Nepal.

Because, assuming that a Nepalese pass has been honestly come by, the difficulty still remains that none of our officials can decipher these passes. It is therefore, possible for a purchaser to cover stolen timber or other produce from the Government forests under a Nepalese pass that has done its duty considerably more than once. Our officials see only that the pass is a Nepalese one, and stamped according to the regulations. But whether it be a new or a venerably old document, this they cannot say.

We have, in our Bahraich forests, so very few fine mature sál trees that extensive thefts of this kind of timber could hardly be committed without our knowledge. But, on the other hand, it would be extremely feasible to steal any other form of timber or produce in the way referred to by me.

For instance, we have noticed the large import of superior asna and asidh poles into Bahraich. Nearly all of these are made to traverse the Motipur sál forests, themselves very rich in the same quality and the same kind of timber. The fraud, if committed in this direction, would not be at all easy to discover, seeing that we are, ourselves engaged in weeding out this class of timber from the forests in question, and in a wholesale fashion that precludes the possibility of our applying a departmental mark to the stumps left on the ground.

Again, the circumstances of the Nepalese forests bordering our own in Sohelwa are, in certain respects, similar to what we find in the Government reserve opposite. Although the former are ever so much poorer, the same class of material, namely, dry sál timber, poles of inferior species, and minor produce generally, is largely exported from both. It is evident that most of the above articles are susceptible of being removed in large quantities without leaving suspicious traces behind. This will be better understood as we proceed. I remember detaining two or three wagons full of dry sál scantling in Sohelwa last year. All had, in any case, traversed the Government forest, since there is no other means of exit from Nepal in that direction.

The one purchaser, or thief —whichever you like to call him—had no pass at all; the other pass bore no seal, or any detail whatever in connection with the purchase. But by the evening of the day of detention all had succeeded in procuring the necessary particulars to their passes. But the question which I should like answered is this: "Were these passes concocted for the occasion by the kindly disposed chaukidar on the frontier?" As I have said before, it would be an advantage to have some control over the persons issuing these passes.

I do not argue at all that frauds on a large and important scale are perpetuated in Bahraich to the loss of our forest revenues. I only wish to show that these frauds are feasible, and very difficult of detection under existing conditions. I, moreover, insist that if a check can be instituted to prevent their occurrence, and that without undue expense, then this check should be imposed.

To me it is apparent that imports of forest material from Nepal should not be, as at present, permitted to find their way into Bahraich by every forest road or cattle track. Moreover, I am of opinion that these imports should be subject to regular inspection and scrutiny on the part of an establishment organized for the purpose, and posted in a manner convenient for the importers and for ourselves. All passes should, after such examination, be duly cancelled and rendered unfit for further use in the forests.

The collusion of the Nepal officials at the frontier chaukies, the possibility of which I have before alluded to, could be removed from the list of feasible acts by our coming to an agreement with the Nepal Darbár, in pursuance of which their forest officials should be obliged to issue to the purchasers duplicate passes in all cases, one of which to be retained by ourselves.

It is obvious that if we then returned all the latter to the Nepalese Commissioner of the district in question, this last named officer would not only have a solid check on his forest revenue, but that the frontier chaukidars would be most careful not to increase unduly the number of vouchers which, later on, they would have to account for. This duplicate system would, of course, also put an entire stop to the employment of old passes on the part of purchasers.

Further on, it will be seen that I strongly advocate this same system of control for our own Government forests, and for the private forests adjoining them. No system of forest control can be instituted without a certain degree of inconvenience to the purchasers, and if we adopt this system in our own case without employing the same means of protection in reference to Nepal timber and produce, the result would, of course, only tend to send still more purchasers to Nepal.

The private forests of the Bahraich district.—In connection with the private forests of the Bahraich district, I am only concerned with those private properties of the kind which are adjacent to our Government forests, and which affect the control of the latter much in the same way that the Nepal forests do.

There are private forests off all the Government reserves in Bahraich. They vary in extent from a few acres only to a few square miles; the largest not exceeding four square miles. In most instances, they are continuous with our own, being separated by a ditch only, a road, or small strip of cultivation.

Again, the circumstances of these private forests are very much the same as what we meet with in our own forests near by. More ruinous, perhaps, which, however, is only one other inducement for the owner to resort to indirect means for making his property last him a little longer. To the dishonestly-minded these private forests offer an excellent cover for the perpretation of thefts of Government material. It is so plausible to say that such and such timber or produce came from private forests; for, as we shall presently see, the declaration is not one easy to confute. There is no reason indeed why the declaration should not be in all cases indirectly true, because our timber and other produce can be smuggled into these private forests with exceeding ease.

The presence of these private forests is, therefore, a very great nuisance to us from the point of view of our control; only less a nuisance than the Nepal forests, because comparatively insignificant in extent.

Classes of timber and other forest produce exported from private forests in Bahraich.—Where our Bahraich forests touch on to cultivation they are, as might be supposed, in a deteriorated condition, and since most of these private forests constitute the outermost fringe of the former, they too are necessarily in poor circumstances. Generally speaking, their condition is ruinous, containing, as they do, only hollow old sál trees and misshapen poles. Some narrow strips are, however, not wanting in good sál poles, while other forests include little beyond inferior species. The exports from these private forests are principally composed of rafters, props, posts, canoes, cattle troughs, and implements of all kinds, the whole cut out of hollow old sál trees. In addition, firewood, charcoal, mohwa flowers, grass, honey, &c., &c., are also exported.

Lines of export for private timber and other forest produce in Bahraich.—From the situation of the forests with which we are dealing, it is evident that the material taken out of them does not necessarily pass through our Government forests. At the same time, much of it does so pass. For instance, most of the timber and other produce from the private forests east of the Bhinga State reserve traverses the latter on its way to the Rapti river, or to places west of that river.

As might be inferred, all, or nearly all, the material exported from these private forests is consumed within the district itself. The timber is too inferior to command the attention of dealers.

In what way the export of material from private forests interferes with our control.—We have thus to contend with the same difficulties in respect of this export from private forests that have been under discussion in reference to the Nepal timber trade. If of much less importance, the former are still more apparent.

The Nepalese, for instance, do mark some of their timber,

and they do supply all their purchasers with passes more or less in order. Again, the sale-marks used by the latter, and the nature of the impressions applied by them to their passes have been duly registered by them in our office—although in an imperfect manner, it is true. But the private owners of forest follow no system whatever. The purchaser obtains a receipted acknowledgment for his money, and this constitutes his pass, his title to the material under his charge. But these acknowledgments, written out as they are on common bazaar paper, without stamps or distinguishing impressions of any kind, naturally afford no clue, of themselves, to the genuineness of the implied transaction. They might, in almost any instance, have been manufactured by the pretended owner himself, or by any other native competent to write his own name. As for sale-marks, proprietory marks on the timber itself, nothing of the kind is ever seen. Naturally, all private timber is, therefore, invested with a very strong element of suspicion. Nevertheless, we are not entitled to detain such timber on mere suspicion, and no law compels private owners of forest within the Bahraich district to submit to such regulations as are necessary in this respect for the common weal. Evidently, all of these people should be legally obliged to stamp both their timber passes, and their timber itself, with distinguishing marks not easy of imitation, and these marks should be registered in our office.

Condition of the Government forests in Bahraich.—The forests belonging to Government in Bahraich either contain but few species that have any present commercial value, or they are young forests, or they are very old and deteriorated forests, or they have been already sufficiently worked pending the appearance of young growth on the ground ; or finally the only mature sál trees met with are all very unsound. There are but few localities in our Bahraich forests whence we can just now consistently remove mature sound sál timber. Narrow tracts of such workable sál forest have been preserved to us in Gubbapur, thanks to the difficult nature of the ground in those parts ; and again, occasional mature good sál trees are found throughout the extensive pole forests of Motipur and Chakia. There are also portions of forest which, in view of their permanent use as grazing reserves, it is not advisable to keep intact, with no other result than the still further deterioration of the stock of mature trees. Here, of course, we are interested in cutting out the latter without regard to questions of conservancy.

Generally speaking, however, the outturn of the Bahraich forests is confined, and must be so confined for a long time to come, to the following :—

Classes of timber and other produce yielded by the Government forests.—

1. Dry sál timber, either in the rough, or converted into canoes and various small scantlings.

2. Canoes, or small scantling, converted from hollow green sál trees.
3. Green sál poles, the result of thinnings.
4. Logs and poles of inferior species, the result (at least the latter) of weedings.
5. Charcoal and firewood.
6. Minor produce, the principal of which are catechu, hides, mohwa flowers, honey, and thatching grass.

The people who come to the Government forests for their requirements in timber and other produce.—At the commencement of this article, I discussed the causes which impelled most persons in quest of timber to go to Nepal in preference to our own forests. Those who obtain their supplies from the Government forests can be summarized as follows :—

1. Dealers and others who have not got on well with the Nepalese officials, and who dare not return to that country.
2. Persons who are very much pressed for time, or for whom the season is now too far advanced for a journey into Nepal.
3. Local dealers, who are always on the watch for dry timber or windfalls or line-timber of *superior quality*, and which, when paid for at ordinary rates only, leave these persons a large margin of profit.
4. Persons who require firewood or charcoal, of which the prices are too low to render necessary on their part a journey into Nepal.
5. Persons who have purchased contracts for various articles of minor produce at the public auctions of the same.
6. The privileged classes of the population (including all persons living within three miles of the forests), who obtain all they require for nothing.

I mentioned previously that I thought the inconveniences complained of by purchasers in their dealings with our officials could be mitigated. This could be easily effected by making the Rangers independent of the revenue collections, or by adding to their number, and thus expediting the work of final measurement. Finally, we should have a tariff of fixed prices for every log, according to mean limits of girth and length, and abandon "Hoppus's Tables." More than this we could not do. Our forests are too poor, and too accessible at all points, for us to be able to establish permanent posts all through our forests for the immediate measurement of material passing through them. With us, the agent of inspection, measurement, and final settlement, must necessarily be a cheap, movable instrument ; and pending its travels from point to point, purchasers must occasionally be exposed to delay. Of all the above people, the "local dealers" and the "privileged populations" alone claim our attention.

The local dealer in material from the Government forests.—Every Government forest in Bahraich has one or more "local timber merchants" living off its borders. The nearer he can approach his place of abode to the forest, the better is he pleased, and his reasons for being so are many and manifest. The "local dealer" is often a great friend of the Ranger, a great friend of every forest official in those parts. These people probably compete among themselves as to who shall be the popular favourite. They are a very great nuisance. They will buy nothing that is not a great bargain, and depend on the Rangers, and the other officials, for the earliest information in regard to anything exceptional and out-of-the ordinary for its quality, or the abnormally cheap rates at which it is to be disposed for. And here it may be remarked how seldom our native Rangers approve of increased revenue rates, how frequently they have occasion to recommend reductions in this respect, with urgent appeals as to their difficulty in inducing purchasers to come forward. And when, at the Ranger's disinterested suggestion, these rates have been reduced, it will be often observed with what singular dispatch the whole of the material in question disappears into the yard of some "local timber merchant."

The proximity of all these timber yards to our forests is objectionable from other points of view. For instance, it is comparatively easy to smuggle timber into them, and that without the connivance of the forest officials. Once in the yard, it is no long operation to so far convert this timber as to make it no longer recognizable. In this way, a few passes may be made to serve for a good deal of timber, and a good deal of timber be disposed of that has never been paid for. Again, the sale of timber by these people interferes in other ways with our control. For instance, we meet a load of timber in transit, not far from our forests, or perhaps passing through them. We demand the title of the person before us to this timber. In reply, he shows us a dirty scrap of paper with just a few words traced upon it in a common hand. This purports to be a receipt in full by a local dealer on account of timber purchased from him. This timber may, or may not, bear Government sale-marks. The presence of such marks only shows that the Ranger gave over this timber to somebody. It does not necessarily mean that that somebody paid anything, or, if he did pay anything, that the Ranger contributed any portion of this payment to the proper deposit for such payments. Far away from the forests, we should have, perhaps, no reasonable right to ask these questions in regard to any timber in transit. Such a course would, perhaps, interfere with the civil rights of the people. But when we meet this same timber only a mile from the Government forests, or actually inside the latter, then surely it is our duty to make all necessary enquiries in reference to it. If then, the timber is marked and wholly uncon-

verted, our only course is to refer to the timber dealer in question. If, after examining the latter's passes, we found no piece of timber which agreed in any way with what had aroused our suspicions, we should conclude that the timber had been dishonestly come by. But since the dealer might deny ever having sold this timber, it would always be necessary to detain the latter pending these enquiries. In other words, we should have to detain all such timber in transit. But we have no legal right whatever to inconvenience the public in this fashion. Moreover, if the timber happened to have been converted in any way, a visit to the timber dealer in question would be perfectly useless, for reasons that I have already given. It is evident, therefore, that, from whatever aspect we consider the presence of the timber dealer on the borders of our forests, that presence is most dangerous to ourselves—much more so, in fact, than that of private forests. When the material collected by these dealers is grass, firewood, charcoal, or any form of minor produce, it is evident that the control becomes still more difficult, because so long as this produce is sold off in proportion to the quantity taken in, it is possible for a single and very cheap pass to serve for a long time indeed.

Legislation required to prevent the conversion of timber within a certain distance from the Government forests, and for placing certain other restrictions on the sale of forest material within the same limits.—If it was found necessary to legislate for the material drifted down our rivers by floods, and to forbid, for this purpose, certain acts within a considerable distance of the latter, it is surely time also that some such similar laws should be enacted for the protection of the forests themselves, against all proceedings that have a tendency to make the control of these forests difficult. This protection would be ensured here by forbidding the conversion of timber within a certain distance from the Government forests by others than *bonâ fide* owners of forest, and by enacting that all material sold by any person within that zone should be covered by the original pass under which that material was purchased, endorsed by its last owner to the person buying it from him.

This method of procedure would entail on us the necessity of supplying dealers of this class with a greater number of passes than, in the case of other purchasers, would be sufficient. The former could not otherwise dispose of their material on retail to the general public, according to their present practice. But it is felt that even this inconvenience would be an improvement on the existing state of things. Evidently also, these dealers should be obliged to register themselves; and it would be an advantage if they were compelled to give security for good behaviour.

The privileged populations—extent of their privileges.—The whole population within three miles of any Government forest in Bahraich is entitled to receive, free of payment, all its require-

ments in timber, fuel, thatching grass, &c., &c., and any other material of forest origin which it might want for *bonâ fide* household purposes.

The sale or barter of this free produce on the part of a recipient evidently, therefore, constitutes an offence analogous to the misappropriation of another person's property, since this produce does not cease to remain the property of Government for all other purposes than that here sanctioned.

On the nature of the difficulties to control presented by our obligations to the privileged section of the community.—When you consider that this privileged population does not number less than 40,000 souls, that our forest establishment is notoriously short of hands for the performance of the most ordinary duties of their class, and that the demands of these privileged people are but little regulated by any circumstance of time, or season, or place, by any correct knowledge on our part of their genuine requirements, or in any other way whatsoever, then it will be easily intelligible to you that our obligations in this direction are a very grievous obstacle to proper control as applied to the forests generally, and that this control cannot be extended with any degree of efficiency to what this privileged population itself consumes.

An intelligent control, even an economical administration, would seem to demand that the indents made by the privileged classes of the community should be supported by something better than their own interested testimony. Yet, in practice, we have virtually to satisfy ourselves with the latter, and with the knowledge that the sale or barter of the material supplied by us would amount to a criminal offence. For it is evident that we have neither the time nor the means to make enquiries in respect of the thousands of indents that thus pour down upon us from all quarters, regardless of time or season, during the course of the year; neither are we justified in exposing the public to the inconveniences which the delay of such enquiries would necessarily subject it to.

A practical control over the consumption of Government property by the privileged people would demand that the indents from each village should be made collectively and at stated periods only, and that these indents should be supported by a declaration as to their moderation and *bonâ fide* nature on the part of a competent authority. And the same course is dictated by the requirements of our control over the forests generally. Let it be said at once that there is nothing so unsatisfactory in connection with the Bahraich State forests as the supervision and control exercised over them, a condition of things mainly due to our position in regard to the privileged population. It is not wonderful that the forest officer should have such strong objection to the privileged system, because it simply cripples all his endeavours to control the property entrusted to his keeping.

And further on, we shall see that it is a cause of immorality to his establishment, and to the public itself.

We have no right to supply the privileged populations with mature trees, but with poles only. The consequence is that the number of trees given over each year is excessive. Where five mature trees should be sufficient, we have to deliver something like a hundred poles. The number of the latter required during the course of every year is, therefore, very excessive. And the demands not being confined by any rules as regards time or season or place, it is evident that we cannot consult the interests of the forest to the extent of selecting all these poles ourselves. Such a course indeed would require an independent and specially trained establishment for the purpose. The result is that we have to submit to these people going into the forest and selecting their own poles. This condition of things has become a positive danger to the forests since Government, on the advice of persons perfectly ignorant of the requirements of forest conservancy, has extended the privileges of the people to species belonging to the dominant stock on the ground. Before Government adopted this course—this most regrettable course—we had the consolation at least of knowing that the operations of the privileged classes in the forests, excepted as they were from the principal trees met with, must of a necessity be conducted over large areas, and partake, in certain localities, at least, of the beneficial character of weedings.

The evil effects of this concession on the part of Government have not yet had time to develope themselves, seeing that it is but a very short time since the news of it spread among the people.

We, moreover, endeavour to minimise the mischief by confining our supplies in this respect to such purposes for which, in reason, they should alone be required. This is perhaps somewhat arbitrary on our part, seeing that Government made no such limitation. But what would be the result if, in the absence of any limitation of the kind, we consented to the people getting just what they asked for—ebony, "asna," and "dhao" poles, for instance, for common fencing purposes? The result could not fail to be that such forests as Bhinga and Sohelwa, in which the above species occur gregariously over considerable areas, would be much denuded. These people naturally do not care to go hunting about for their requirements, and concentrate their fellings wherever circumstances will admit of their doing so. Concentration of this nature signifies denudation, and ruin. It is as well to call facts by their true names.

We have, I have said, to submit to the selection and felling of trees within our forests on the part of the privileged populations themselves. The consequent waste is, of course, great, and there are other evil results besides those already mentioned. For instance, it is impossible to get them to cut their poles flush

with the ground, hence not only waste of material, but a barrier to the appearance of the coppice which would otherwise have replaced the trees thus removed.

Of course, our inability to mark ourselves all these trees given over to the privileged people adds immensely to the difficulties of our control. This is sufficiently explained from the fact that the presence of fresh signs of felling within the forests may signify either one of two things: that material has been stolen, or that privileged villagers have been operating there. In fact this alternative makes control impossible, when applied to the inferior species. When officers in high position comment on our assumed parsimony and want of generosity in regard to all privileges to the people, it would be as well if they bore in mind our real motives, which are motives of control, and not attribute to forest officers harder hearts than they possess themselves. Further on, we shall see that forest privileges on an abnormally large scale are conducive to immorality and corruption on the part of all the parties concerned in the distribution of the produce.

The method of check in use for controlling the supplies given to the privileged classes.—Although we have, in most instances, no practical means for determining whether or not the indent submitted by the privileged individual is justified by his actual requirements, and that it is often doubtful whether the person indenting is a privileged individual at all, yet we have, of course, been driven to impose certain maximum limits beyond which we refuse to supply without further enquiry into the circumstances of the case.

These limits are so liberal in themselves that any demand over and above them would necessarily call for an explanation. They are, in fact, based on what should be sufficient to construct, at intervals of a year, a new house, a new plough with spare share, a new cattle enclosure, &c., &c. But, in respect of fuel, they are based on as much as the person can carry away on his head during every day of the year.

In a former article of mine in the *Forester* on the subject of the privileges in these forests, I made the mistake of saying that there were no limits to the indents which could be made by the privileged people. We have limits, although they have not any legal sanction, having been dictated by motives of pure necessity. Moreover, being open to all kinds of abuse which, under our existing arrangements with the privileged populations, we are powerless to prevent, these limits have no practical use, no real efficacy.

Apart from the fact that, in such a large community, it is impossible to discriminate between the privileged and the non-privileged, it would be too much to expect from our officials that they should have such a memory for faces as to be able to recognize all those who came more than once with the same

indent during the same sanctioned period. And then it is, of course, easy for such a would-be rascal to gain his object at any time by getting some other person to represent him. In the case of all timber requirements, the privileged indenter has to provide himself with a permit. By these means we have at least the advantage—if it is one—of being able to distinguish in the forest between the downright, open, unblushing thief, and the more wary, circuitous, plausible scamp who has elected to shield himself under cover of a licence obtained from his friend the guard, or perhaps his friend the Ranger, with or without payment of a consideration.

In the case of fuel it would be manifestly impossible for us to grant any permits at all. Being a daily indent on the part of so many thousands, this fact should explain itself. Nevertheless, we have our little endeavour. Those wanting fuel proceed before the guard of the block contiguous to their abode, and this official stamps each applicant somewhere on his body with a composition of charcoal and water, warranted, without extreme care and neglect of the proper ablutions, not to last for more than the day in question. Persons taking any fuel without these marks upon them are assumed to have no right to the privilege.

At the best this procedure is a clumsy and makeshift expedient, and can be only excused in the absence of any other deterring conditions. In practice, we cannot apply an intelligent check to the present considerable consumption of fuel by so-called privileged persons, unless the indents are made collectively by the inhabitants of each village, and after stated periods only—not less than one calendar month.

The Ranger keeps registers, in which are entered the particulars of each indent granted to a privileged person. But, for reasons already mentioned, the value of the data contained in these registers should not be too much relied on.

It will be seen that, to all intents and purposes, the Rangers, and in certain cases the guards, are masters to extend the application of the privileged rules to all such persons whom it may be in their interest to befriend. It is probable that the whole privileged system is regarded by the underpaid subordinates of the department as a providential means for adding on to their miserable stipends, and for gratifying a petty love for tyranny in regard to such as are too poor to be able to respond to their demands. No doubt, among the privileged populations themselves, the privileges are abused for the purpose of an illicit traffic between themselves and the less fortunate people beyond their limits. Cases of both forms of corruption have been before the Magistrates, and would be more frequent if we had the means, and the legal right, to do police duty on the confines of the privileged zone.

Such extensive privileges as those accorded in the Bahraich

forests constitute a barrier to any efficient system of control, and sow corruption and discord among those who receive, and those whose office it is to supply.

Table showing the maximum limits within which each privileged person is customarily supplied.—I now proceed to give, in full, a statement showing the maximum limits already referred to, within which each privileged householder is customarily supplied. Exceptions are, of course, made in cases of fire, floods, or any other unavoidable contingency.

A.—Timber for House-construction—

38 rafters,	or "koros,"	(girth	8"-10",	length 10'-12').
3 posts,	or "táms,"	(,,	18"-36",	,, 12'-15').
6 props,	or "túns,"	(,,	18"-24",	,, 5'- 8').
1 ridge-pole,	or "bandir,"	(,,	24"-36",	,, 15'-25').
2 wall-plates,	or "sardals,"	(,,	18"-24",	,, 15'-25').

Total, 50 pieces, of a total cubic capacity of 50 feet.

B.—Timber for Implements—

1 Harrow, or "saráwan," (42" girth by 15' length).
1 rice-press, or "óklee," (42" ,, ,, 3' ,,).
1 yoke, or "máchis," (from dry material on the ground.)
1 plough-handle, or "jhanjha," (from dry material on the ground.)
2 plough-shares, or "khopi," (from dry material on the ground.)

Total, 6 pieces, of a total cubic capacity of 20 feet.

C.—Miscellaneous—

8 machán-supports, (18" girth by 8'-12' length.)
500 púlas of thatching grass.
5 head-loads of withes } cut generally from smaller branches
25 head-loads of thorns } of bushes.
1 head-load of firewood (not sál) per diem, or
1 2-bullock cart-load per mensem.
10 posts for cattle-enclosures, (18" girth by 4'-5' length.)

Total cubic capacity of timber per annum = 90 feet.
,, ,, ,, fuel ,, ,, = 600 ,,

The system of control employed in the Government forests of Bahraich. General remarks.—Most of what has been written by me in the preceding pages related in some way or other to circumstances tending to obstruct the course of control within the Bahraich Government forests, and to take away from its efficiency. In this way, I reviewed the unfavourable influences exercised on this control by the absence of a corresponding check on the exports from the Nepalese forests and from private forests adjacent to our own, by the presence of timber dealers on the outskirts

of the Bahraich reserves, and by an extensive system of irregulated privileges within the latter.

Control is, of course, but a general term indicating the means of prevention employed in reference to the occurrence of a state of things contrary to our wishes. In connection with the present subject, we are only concerned with the means of prevention made use of by the Department for opposing thefts of material on the part of the public, and thefts of revenue on the part of our officials. I shall deal with both sides of the question separately. For the purposes of this chapter any one means of prevention can be denominated a check.

The check exercised on the proceedings of the general public within the Government forests of Bahraich.—It is evident that respect for the property of Government, as seen in timber and other forest produce, is principally maintained by the help of our establishment of rangers and guards, who, to this effect, perform the functions of ordinary police officials. But to facilitate and render more fruitful of results the operations of this protective force, it is always necessary, in a forest control, to have some ready means for distinguishing between those who have authority for what they are doing in the forest, and those who have no such authority. This end is attained, in the Bahraich forests, by a system of permits and passes, and timber marks. This I shall now proceed to explain in detail.

Permits.—The intending purchaser of material from a Government forest in Bahraich has, first of all, to provide himself with a permit from the officer in charge of the range to which that forest belongs. This permit constitutes the purchaser's credentials, the justification of his proceedings within the forest. It is, therefore, a very necessary instrument. Even the Nepalese think so, as we have already seen. To obtain the permit, the purchaser has to pay a first instalment on the probable cost of his purchase. This instalment—generally equivalent to a third of the value of the purchase—is our security for the good-faith of the permit holder. Without this security, much loss would ensue to Government, and much injury to the forests, through the abandonment by the permit holders of material felled or collected by them, as also by the neglect of some one or other important forest regulation.

The possession of a permit by all authorized persons enables us at once to discriminate in the forest—assuming, of course, that the said permit is a valid one—between those who have a right to what they are doing, and those who have no such right.

In the permit are entered the instalment paid by the intending purchaser, the date of the transaction, the man's name and residence, the kind of timber (dry or green, log or pole, sál or other species) or other material that he is in quest of, the locality whence it is to be obtained, and the spot to which he must subsequently transport it for purposes of measurement.

It is, moreover, stipulated in the permit that its holder shall not be longer than six months in settling his accounts with the Department.

Permits have to be given up by the purchaser when no longer required by him. They are then submitted to the divisional officer who sees them cancelled, and made unfit for further use. Were this not done, some purchasers would be tempted to act dishonestly on the next occasion for their requiring material from our forests—a proceeding rendered more easy in Bahraich perhaps than elsewhere by the ignorance of the guards, most of whom can neither read nor write.

The permits are supplied by the divisional officer in books similar, in all respects, to ordinary bank cheque books. In the same way, each permit is serially numbered, and has a counterfoil attached to it. The necessary headings in these permits are printed in Hindi, and in Persian.

Passes.—When the purchaser has transported his material to the place appointed for measurement, and has succeeded in getting the proper official to take these measurements, and to settle his account with the department in accordance therewith, he is entitled to obtain a receipt for his money and a declaration of his right of ownership in that material. This is effected by means of the pass. The pass contains all necessary particulars in connection with the transaction. The purchaser's name is entered in it, his place of abode, the kind of timber or other material bought, the number and measurement of the pieces, the date of purchase, &c., &c.

The pass is the purchaser's sole title of ownership in the material corresponding to it. Passes have their headings printed in Urdu and in Hindi, and are issued to the proper officials by the officer in charge of the division, who, first of all, takes note of the numbers of such issue. Like the permits, the passes are bound in book-form, each book containing a given number of passes with their attached counterfoils, and each pass bearing its own serial figure. Unlike permits, however, the pass continues to remain in the custody of the purchaser. This calls for no explanation.

Of course, there is danger of a pass being made use of by the purchaser to cover more than its one and original purchase. In Bahraich, where so few of the protective establishment can either read or write, this contingency is especially to be guarded against. We shall return to this subject further on.

Timber marks made use of in the Bahraich Government forests.—Timber marks are generally employed for four distinct purposes :

(*a*), to distinguish trees that we wish to fell from trees that we desire to maintain standing ;

(*b*), to show ownership in the timber ;

(*c*), to indicate that the timber so marked has been sold and paid for ;

(*d*), to indicate that the timber so marked has been duly examined at some particular inspection post.

In Bahraich, the divisional officer has all green mature sál trees that are about to be felled, marked, in his presence, with an impress only used for that purpose, and which he keeps under lock and key. Green trees of other species are similarly marked by the Rangers, who have their mark for the purpose, also kept under lock and key.

Dry timber of all kinds, windfalls, drift timber, line-timber, &c., &c., is marked for intending purchasers by the guards, deputed for that purpose by the Rangers. It would evidently be an advantage if this task was not delegated to such inferior subordinates; but it is impossible that the Rangers can themselves attend on all the purchasers for dry material, and other inferior classes of timber. There is, unfortunately, therefore, no other alternative. The object of marking at all dry and fallen timber is to afford evidence, in any particular case, that the felling or conversion of such timber within the forest is being done by authority, or not. Without this practice, the presence of a recently felled dry sál tree, or of a recently logged windfall on the ground, would give us no information as to whether such timber had been operated upon by a duly titled purchaser or by a thief. The Bahraich forests are so surrounded by a dense population of cultivators, that many small precautions are rendered necessary that would be futile in other forest districts. Of course, the marks used by the guards would be of no avail for any other form of timber. I have previously referred to the fact of our inability to mark the thousands of poles removed every year by privileged villagers. The inference is that we have no means of checking the illicit felling of this class of timber, which includes almost all other species but sál below the dimensions of 3½ feet in middle girth. This is a very serious matter, but there really appears to be no help for it. In Europe we should be able to amend such a state of things by confining the operations of these people to stated localities each year; but in India the protection of the forests at all appears to be, in these cases, dependent on an implied understanding that the surrounding populations are not to be inconvenienced in the least degree. And, of course, to make a villager proceed five miles for his timber instead of two miles, as formerly, would be to inconvenience him. People refuse to understand that the result of non-interference must be that this same villager, or his children or grand-children, will have to travel hereafter five miles whether he or they like it or not, and that without the prospect now afforded of being able, after a time, to shorten the distance. These things do not belong to the politics of the day.

In certain cases, we have to mark Government timber with a distinguishing impression, so that it may be easily recognizable amid timber belonging to other parties. For instance, if we

are about to despatch sleepers to any station outside forest limits, it would be necessary for us to apply the Government stamp to each of these sleepers. A recent serious robbery of Government timber in Bahraich was mainly brought to light by the presence of these proprietory marks.

All timber sold by us in Bahraich is stamped with the sale-mark. This mark supplies us with a most useful accessory check. Because the absence of sale-marks on any timber in transit, or collected near to our Government forests, would alone suffice to arouse a reasonable suspicion of that timber having been stolen. Evidently, however, the pass is the only irrefutable evidence of ownership in any class, or kind, of our forest material. In many instances, the material is not susceptible of even receiving a sale-mark; witness fuel, and nearly the whole lot of minor forest produce. Here, there is nothing but the pass to confirm the lawful removal of the material. This is, of course, a great, but unavoidable, drawback when there is nobody near of whom to make enquiries; although the presence of sale-marks is not necessarily conclusive evidence as regards the material in question, unless supported by a pass in due order, and corresponding with it in all respects. Without such a pass, this marked material might indicate a number of possibilities. The material might have been stolen from some other purchaser, or somebody might have become possessed of the Ranger's sale-hammer, or the Ranger himself might not be an honest official.

Value of all the preceding instruments of check on the proceedings of the public within the Government forests.—Taken together, all these different methods whereby the lawful purchaser can be distinguished from the dishonestly-minded, are in themselves excellent, and should be sufficient for our purposes, but for a variety of causes which take away from their real value and practical utility.

One of the most serious of these causes is seen in the ignorance of our forest guards, but few of whom can either read or write. The use of old and invalid passes is, thereby, rendered a comparatively easy proceeding, as also the subtraction of material in excess of what has been entered in the pass. In a similar manner, it is possible for a dishonest official to give away, along with the pass issued by him, material that is not mentioned in the latter, conscious as he would be of the small probability of the discrepancy attracting attention. Because, practically, since there are no regular inspection posts in Bahraich for examining material passed out of the forests under the authority of the officials whose duty it is to issue passes, our illiterate guards constitute the only obstacle to the commission of such very possible frauds as the above. The control, in the field, of the officer in charge has not that value in Bahraich which it otherwise would have, because of the very scattered nature of the

forests in that district, and the consequent impossibility of exercising, at his hands, a continuous supervision of the kind demanded. The two most valuable forests in Bahraich are 40 miles asunder, and each of these has an area of from 120 to 170 square miles, being, moreover, themselves cut up into isolated groups that cover an extensive line of country. It, therefore, happens that when the one superior officer in Bahraich leaves the one important extremity of his division for the other, the Ranger in charge of the former can accurately depend on not seeing him back again, under ordinary circumstances, for at least a month. In the meantime, the same Ranger, if at all so inclined, could, with very little risk to himself, abuse his powers to a considerable extent.

Granting again that all the smaller officials could read—and we find it extremely difficult to procure able men of this class on the present scale of salaries—there are not enough of them to render serious service in this direction.

Moreover, without any ulterior check on their own acts, I much doubt whether we should place too much reliance in these lower subordinates. Under actual conditions, I think it more than probable that they see in stolen material only an occasion for adding on to their store of ready-money, when such can be done safely. It is the poor and the helpless whom these people bring forward in periodical illustration of their zeal.

I have referred at such length to the difficulties of control engendered by the nature of our relations with the privileged populations, with the Nepalese and other owners of forest, and with timber merchants living off our own reserves, that it will be unnecessary for me to return to the subject. Hitherto, I have freely suggested remedial measures in respect of all circumstances that tended to affect our control or our revenues in an unfavourable sense. In the present instance, my recommendations will find their proper place at the conclusion of what I have still left to say in connection with the control of the Government forests.

The check exercised by the Divisional officer on the proceedings of his subordinates.—The check exercised in the Bahraich Government forests by the officer in charge, on the proceedings of his subordinates, can be divided into :—

(*a*), the field-check, and

(*b*), the home-check.

The former results as a consequence of the personal supervision and inspection of the forests, and of all material in transit, or collected within or near to the forests.

This form of check hardly calls for any remark. It is evident that the more often the officer in charge looks after his forests, the less risk will there be of his officials abusing the powers conferred upon them, and entering into a criminal partnership with the public.

Constant and repeated supervision on the part of the divisional officer and his superior assistants—if he has any—is, therefore, the one great deterrent of forest offences. I have mentioned how it is that, in Bahraich, this very necessary supervision is rendered difficult by the special circumstances of the district, and how, in consequence, *the Rangers are left too much liberty* of action. Certain classes of forest offence can, of course, be discovered after long lapses of time; lopping, for instance, or tapping trees for resin. Conducted on an important scale, such operations as these would, unless previously reported, at once point to collusion with the forest officials; so also would repeated grazing within a closed tract unaccompanied by the seizure of cattle. *On the other hand*, we have seen that, in certain circumstances, a number of abuses, and offences, such as thefts of young trees of inferior species, dry timber, minor produce, &c., &c., can be effected without leaving any suspicious traces behind in the forests. Under the special conditions of the Bahraich Government forests, therefore, the field-check resorted to by the officer in charge is not the valuable and fruitful element of control that it is in other forest districts.

The home-check is that check which results on a comparison of permits and passes issued to purchasers with the counterfoils, or duplicates, of the same. The latter constitute the vouchers in support of the revenue statements submitted by those officials whose duty it is to issue these permits and passes. *In Bahraich we have seen that it is the Rangers who do this.* The particulars entered by them on the permits or passes issued to purchasers have to be entered by them, likewise, on the corresponding counterfoils, the latter subsequently going in with their monthly accounts. It is evident, therefore, that the particulars of each permit or pass issued by the Rangers should agree in all respects with their counterfoils, and that the particulars on the pass and its counterfoil should also correspond with the material delivered.

As applied to the first instalments of revenue received by the Rangers, this check is ample and sufficient, because the original permits have to be returned to the head office after issue of the corresponding passes.

It is, *moreover*, of very little concern to us how much the purchaser has paid in the first instance, so long as we receive the proper amount at the time of settlement, that is to say upon his receipt of the pass. For the purposes of this check, therefore, we are only seriously concerned with the passes. All that we have to do with the permit counterfoils is to see that they have been issued seriatim, that they are all accounted for. It *is evident that, in regard to the passes themselves, the check is* entirely dependent on the occasions that we have had for taking note of the originals in the hands of purchasers; and I have already more than once reverted to circumstances which tend to

3 x

make those occasions few and far between, or which make it easy for intending rogues to time their operations by the periods of absence that intervene between the superior officer's visits to the same forest—periods which, as I have said, are necessarily frequent and continued in Bahraich.

A comparison of the kind referred to should reveal some one of the following facts :—

(*a*), that the pass and its counterfoil agree with one another and with the material corresponding to it. In this case, of course, the account is a correct one.

(*b*), that both counterfoil and pass agree with each other, but not with the corresponding material.

In this case, if the value entered in the pass is greater than that of the material, the difference will, no doubt, be due to an error of calculation. If the opposite, then the discrepancy may have originated in the same way, or in an attempt to defraud. The evidence in favour of the last conclusion will, of course, vary with the circumstances of the case, and with the gravity of the amount that has not been accounted for. You may accept it as granted that the official will always have some natural cause to which to attribute the discrepancy in question. And he has always a very plausible excuse at his command, namely, that carelessness in measuring quantities of which the very best among us are, occasionally, capable. For this same reason you may, with justice, conclude that no difference is ever found, in practice, between a pass and its counterfoil.

Of course, if the excess timber had not been found marked with the sale-hammer, the responsible official would be in a position to say—although not necessarily with reason—that the purchaser must have stolen it subsequently to receiving the pass from him, and that with or without the collusion of his subordinates.

Remedial measures.—When any remedy, or improvement, has suggested itself to me in connection with the many questions treated of in this article, I have usually concluded by mentioning it. The measures which would, in my opinion, therefore, add to the value of our existing system of control for the State forests in Bahraich, have, in part, been already explained, since nearly all of the questions previously discussed have, directly or indirectly, related to that control. The last chapters had for subject the methods of check in operation for controlling the material disposed of to purchasers, and for restraining the proceedings of our officials within the sphere of the trust committed to them. I have been obliged to recognize the fact—fact, in my opinion—that, owing to the existence of a number of special circumstances, the methods of check employed by us in Bahraich, most excellent in themselves, are in reality more or less abortive of results. For the deficiencies last mentioned by me, I can, after recommending the very necessary strengthening of the

establishment, suggest no better remedy than that already briefly referred to by me in connection with the questions of Nepalese and private forests. I urge once more the maintenance of inspection posts for the examination of all material passing out of the Government forests. I have calculated that nine or ten such posts would suffice for the division, and that purchasers would not be subjected to any unreasonable inconvenience by being obliged, by law, to report themselves and their material at these posts. I have calculated, moreover, that by making all conveniently situated police stations do the duty of these inspection posts, the latter could be reduced to about five or six. This is not very excessive. It is evident, as I have already had occasion to remark, that it would not do to subject one owner's property to this system without doing the same with all, although I only refer here to the Nepal forests, and to such private forests as lie very near to our own. We do not wish to afford purchasers still further reasons for shunning the Government forests. We have seen, moreover, how very desirable is this control of Nepalese and private material, and that, in its absence, our own must continue unsatisfactory.

At each inspection post, as above, I should recommend having one mohurrir on Rs. 8, and two chuprassies on Rs. 4 per mensem. Instead of issuing a single pass, as at present, the Ranger would, under my proposal, give two passes along with each purchase, one of which the mohurrir at the inspection post, or chaukie, would keep, subsequently submitting the same to the head office for purposes of comparison with the Ranger's corresponding counterfoil voucher, with which it should agree, as already explained. Of course, the material would have to be examined at these chaukies and compared with the corresponding passes, and it would have to be seen that the latter were not old and invalid, or forged, or otherwise insufficient. Suspected material would have to be detained pending further investigation.

We should have necessarily to be careful of collusion between the "chaukidars" and the purchasers. But if the district police—in their capacity of guardians of the property of the public—were directed to scrutinize all timber in transit, and to compare covering passes, I think we might feel fairly safe against such a contingency. The Rangers being, by these means, left in uncertainty as to the number of busy persons who might interest themselves in their transactions, would be careful of committing themselves, and the inferior officials would have to follow in the same line of conduct.

It will be seen that the measure here proposed only tends to approach our system of check, as near as circumstances will permit, to the excellent and well-known "Khám-tahsil" system made use of in parts of the North-West Provinces.

Conclusion.—In conclusion, I desire to make it perfectly well

understood that, in composing the present article, I have not been moved by any inclination to indulge in offensive criticism of a condition of things instituted under the auspices of my seniors, in accordance with an experience and knowledge of the subject which should be much greater than my own. In writing this article, I have been prompted by two considerations: firstly, to describe and publish circumstances which can but be of great interest to all forest officers, as also to district and other authorities connected with Bahraich, and subsequent officers in charge of these forests; and secondly, to give an exposition of my views in respect of what should constitute an efficient control under circumstances of special difficulty. I have done my best to achieve these results without presumption, and without any offensive display of superior wisdom, as also without indulgence in the morbid practice of "picking holes" in schemes of solid usefulness. But without a consideration of the weak aspects—as seen from my own point of view—of each of the questions treated by me, my subject necessarily fell to the ground, and a discussion of much instructive importance became impracticable.

It is to be hoped also that the reader will find useful information in my article quite apart from my forced criticism of the good and the bad points in the methods of check applied to the illicit removals of material from the Bahraich Government forests.

It must not be supposed for an instant that the measures recommended by me in the preceding pages, the openings for fraud pointed to by me, are in any way connected with the presence of an abnormally corrupt condition of things in Bahraich. I do believe that, under cover of the privileges, much undiscovered theft is committed, and that the guards are in no way to be depended upon. But I have every reason for knowing my Rangers to be singularly honest and upright men, a circumstance to which I attribute the almost total absence of evidence in support of the commission of those graver abuses which, as I have endeavoured to show, nothing in the machinery of our control itself conduces to render difficult.

Of course, such an admission on my part—an admission which it gives me the greatest pleasure to make—militates in nothing in favour of a state of things which is, in my own opinion, an inducement and a temptation to those who are not honestly disposed.

But what I wish to be well borne in mind by the reader is that nothing in the preceding pages has been written in any personal sense.

My object throughout has been to describe the action of a certain human mechanism, and in doing so, I have assumed it to move in that moral atmosphere which is most commonly met with under the circumstances of the case.

CAMP BAHRAICH:
24th September, 1885.

E. P. DANSEY.

FOREST ORGANIZATION FOR BEGINNERS.

CHAPTER I.—INTRODUCTION.

BY *organization* is meant the division of a forest into groups, the determination of the quantity of material they contain, and of the quantity of wood which may be annually, or periodically, drawn from the forest in order that the proprietor may derive the greatest possible benefit from the soil.

It will generally be found that a forest consists of groups of trees distinguishable from each other by differences of height or species. Here we may find a collection of blackwood-trees 40 to 50 years old; there one of the same, or another, species, consisting of trees 90 to 100 years old; or, again, we may find a group containing more than one species, but still with trees, in the main, of about the same height; sometimes, we come across groups containing trees of very different ages, but this form of aggregation is less common, because, in groups growing naturally, the higher, or older, trees gradually suppress by their shade, and sooner or later kill, the lower, or younger, ones, so that it is only when a group is very open that we are likely to find trees of all ages mixed up together. A forest, therefore, consists of a number of units which are well-defined by reason of their differing in height, age, species, density, or other marked feature, and a stretch of forest which appears tolerably uniform in respect of such qualities is technically called a *group*. As a rule, it is not convenient to have a group occupying much over 100 acres, but often a far larger area is found to contain a uniform mass of forest, and it then becomes necessary, for the sake of convenience in organizing the forest, to split it up into two or more groups. It is usual to separate such groups by roads, or *rides* as they are called technically, and each separate portion then forms a distinct group. Other suitable means may be substituted for rides; a canal, or road, for instance, which forms a suitable line of demarcation. The area occupied by a portion of forest so isolated is called a *compartment*. On the other hand, a group is often too small to be separated by means of unproductive rides, and in that case a compartment is made to include two or more groups, which, when their lines of demarcation are not naturally distinct, may be separated by narrow lanes, a few feet broad, cut through the forest; by small mounds of earth at the angles; or by any other inexpensive means; and the area occupied by each group is then called a *sub-compartment*.

It is evident that, in order to carry out the formation of compartments, a map showing at least the boundaries of the forest is necessary. The organization of a forest should, therefore, be preceded by a survey of its boundaries, and also, if possible, of its topography generally, a good plan of which

greatly facilitates the splitting up of the forest into compartments.

The operations of organization and the survey of forests may be classified as follows :—

I. THE SURVEY OF THE FOREST AREA.

II. DIFFERENTIATION—including the formation of compartments, sub-compartments, rides, and roads for the extraction of the produce.

III. ASSESSMENT—which includes an estimate of the age, height, quantity, rate of growth and value of groups, and all other estimates concerning the present or prospective value or yield of material, such as, for instance, of thinnings.

IV. DETERMINATION OF ANNUAL, OR PERIODICAL, YIELD.

V. A PLAN OF OPERATIONS—showing the parts of the forest to be cut, thinned, and re-stocked during a given period (usually 10 to 20 years).

The object of this somewhat elaborate procedure is, in the first place, to find out the most advantageous revolution for the forest.* This generally depends on what description of wood, which the forest is capable of producing, is most in demand in the vicinity. Secondly, it may be necessary, in order to determine the maximum uniform yield possible during a revolution, or period. But it is not always necessary to carry out all operations noted above ; the degree of elaboration increases with the length of the revolution. The simplest process suffices for a coppice-forest ; all that is necessary in such a case is to divide the forest into a number of compartments equal to the number of years in the revolution, which for coppice never exceeds 40 years, and in this country need seldom exceed 15. Supposing, for example, we have 100 acres of tolerably uniform-

* The term *revolution* is used to denote the number of years fixed to elapse from the production of a group to the time of its being harvested.

I am told that this term is un-English and bad, and that *rotation* is the proper word to use. My objection to the latter is, that it has been long used in our language to express successive changes of species in cropping land, and that it is, consequently, misleading when employed in the sense in which foresters wish to use it. Revolution may not be a very good term, but it is, at all events, not misleading. As for its foreign appearance—which may, or may not, be the case—that is, I fear, a charge which can be brought against a great number of our terms. Of the two, it seems to me that revolution is certainly the more apposite. No doubt, it was the revolution of a wheel which first suggested the term, because at the end of one revolution of a forest, or a wheel, you expect to come back to the starting point. But it is not usual to speak of a rotation of a wheel, revolution being the more correct term when you wish to convey the idea of one complete circuit. Again, revolution does not necessarily convey the idea of motion in a curve, whilst rotation does; but cuttings never progress in a circular direction. I do not set much value on refined distinctions of etymology; but I must confess that, from any point of view, the term here chosen seems to be preferable to rotation.

ly stocked forest under the coppice-régime, and subject to a revolution of 20 years. Evidently, we may cut 100 ÷ 20 = 5 acres of forest every year without exhausting the supply, and the simplest plan would be to divide the whole area into 20 compartments of 5 acres each, and to cut one yearly, and so on for ever, always cutting the oldest group. We would then have what is called a *sustained* yield. The ideal to be aimed at in most cases is the cutting of an equal quantity of material every year, so as to avoid flooding the market during one year or period, and leaving it almost destitute of produce the next, because, setting aside the inconvenience caused to the consumers, the proprietor of a forest must suffer considerable money-loss by maintaining a fluctuating instead of a regular yield. The case of a forest worked chiefly for timber, and subject, therefore, to a much longer revolution than coppice, is less simple. It is then necessary to estimate the cubic contents of the oldest groups, at least, and to calculate the yield carefully, by methods hereafter to be described, because even in old groups of the same age and density there may be very great differences of yield per acre, and the yield cannot be fixed by area alone: sometimes the estimated cubic contents and rate of growth of the standing-stock constitute the sole guides to the quantity of material to be exploited.

SECTION I. SURVEY OF AREA.

CHAPTER II.

The survey of a forest, which has just been shown to be a necessary preliminary to its organization, differs in no way from the survey of any other object. I shall, therefore, take for granted that the student has a sufficient knowledge of the subject, and confine my remarks, in this section, to a discussion of the scale on which a plan of the forest should be made, to the method to be employed, and to the amount of detail to be included.

As regards the first point, it is unnecessary to say that, other things being equal, the larger it is up to a certain point, the more useful will be the map for our present purpose. The scales employed by the principal States of Europe vary from 1 ÷ 5000 to 1 ÷ 3200 (12½ to 20 inches to the mile). In India, a scale of 4 inches to the mile (1 ÷ 15840) has been very generally adopted. It is, however, too small to admit of all boundaries being shown on, or of the measurement of areas from, the map: it is, in short, too small to afford a really useful working-map, but answers well enough for mere inspection-work. So small a scale should, therefore, only be employed where very rough estimates of yield will suffice, that is, where

there is no fear of exceeding the capability of the forest, or where the forest is of little value, but in such cases the question may well arise as to whether the forest is worth surveying at all. As a general rule, we may assume that, if a forest is really worth surveying, it is most economical in the long run to employ a scale of not less than 8 inches to the mile ($1 \div 7920$) which is the very smallest capable of giving satisfactory results: a scale of 12 inches to the mile is much to be preferred if the value of the property is considerable.*

* I wish to note here, that a friend, who has kindly looked through the proofs of this paper, considers a 4-inch scale suitable for maps of all Indian forests, excepting the very best: that, for inspections, plans of all important forests are absolutely necessary: that the 4-inch maps can be enlarged, and more detail added, when required: that maps of the School Circle, N.-W. P., on the 4-inch scale suffice for elaborate working-plans: that, if the 12-inch scale be adopted, the cost of surveys will be enormous: that German foresters consider the 4-inch maps of the Indian Forest Survey branch as already too elaborate and costly.

My friend's argument does not, however, affect my position, which is that really useful working-maps must be on a scale sufficiently large to show all the boundaries of forests and groups, and enable the forester to make fairly accurate measurements of the areas of sub-compartments from them. Now, a scale of 1 : 15840 is, I submit, inadequate to fulfil these conditions; therefore, I maintain that, if maps on a smaller scale than the 8-inch (which I consider a useful size) are made, accurate methods need not be resorted to, and that it is waste of money to spend large sums for elaborate trigonometrical and topographical surveys on the 4 inch scale. No doubt highly elaborate working schemes may be framed for forests mapped on this, or even a smaller scale; but how, then, about the accuracy of the data on which this elaborate fabric is raised? If the foundation is shaky, the stability of the superstructure must also be uncertain; and how much more so, it is difficult to say when, as in the case of working-plans, almost all calculations are the result of generalizations from comparatively minute data. Generally speaking, I do not think elaborate topographical maps are necessary, at all events in the first instance. Probably the heavy expenditure considered necessary for surveys on a larger scale than the 4-inch is ascribable to a desire to include a mass of detail when perhaps very little would suffice. It seems to me that the best plan to follow when it is necessary to have vast areas surveyed on a uniform plan (tracts which cannot, in the nature of things, be all suited to the same system) is, first of all, to make outline maps of the whole, giving only the most essential details, such as roads and rivers, and gradually to fill in minor details for any forest to the extent that may be found necessary from time to time. A great deal, perhaps all, of this after-work could be accomplished inexpensively by the local forest staff, and it would be greatly facilitated and cheapened by the differentiation of the forest.

The opinion, ascribed to German foresters, that our maps are too costly and elaborate, is not, therefore, opposed to my own; on the contrary, I feel confident that men engaged in organizing German forests would readily admit that the 4 inch scale is too small to afford satisfactory working maps.

As regards the argument that large scale maps are not necessary because small scale maps can be enlarged, all I need say is that it is very odd, if that be the case, that surveys on a large scale are ever made, as it would be so much more simple to make them on a small one. The fact is that scarcely anything is gained by enlarging maps on a very small scale; it simply means the reproduction of all the errors inseparable from the minor scale, plus the disadvantage of having less handy and more expensive maps.

The method to be employed must also depend on the immediate or prospective value of the forest. Any body can see at once that it would be folly to spend a large sum of money in surveying a forest consisting of scrub, which could never within a measurable period return more than, say, an anna per acre per annum. A cheap method, such as a survey with prismatic compass, showing only the most essential details, is indicated in such cases. But in more valuable forest, it is advisable to fix the boundaries at least by means of a theodolite-survey, and minor details with prismatic compass or plane-table. The most important details for purposes of organization, and which should all be included if circumstances admit, are—lines separating portions to which different rights are attached (*e. g.*, "reserved" from "protected" forest); all important physical features—such as canals, streams, roads, hill ranges—likely to affect the laying out of compartments or the working of the forest. Sometimes a general trigonometrical survey of the cultivated lands of a large tract of country affords a good opportunity for having the forest-lands comprised in the area surveyed at the same time. In such cases, it may not always be convenient to include as much detail as is desirable for the settled land: the scale of the two must of course be the same, but the amount of detail to be included for any forest should be regulated according to its value and the prospect of its requiring to be organized within a reasonable period. There could be no object in making an elaborate survey of a forest which would not, in all probability, be organized for an indefinite period, and the most that would be justified under the circumstances would be the fixing of the boundaries. A reliable framework of its limits would thus be obtained at a comparatively slight cost, and the foundation laid for a detailed survey whenever the occasion might arise, and that too, if required, by men who need not be highly accomplished surveyors. Then, when the forest came to be organized, if professional surveyors were not available, the survey could be completed by foresters who had gone through a course of instruction at the Poona College or at Dehra Dún. It is certainly difficult to exaggerate the importance to a forest official of possessing some facility in practical surveying, not merely on this account, but mainly because no one ignorant of the subject is competent to carry out certain essential operations of organization, which, for want of a better word, I have grouped together under the term *differentiation*, and which can be properly carried out only by professional foresters.

(*To be continued.*)

NOT SPORT BUT A NECESSITY.

WILD pigs are, in places where they cannot be ridden, an unqualified nuisance : and cases are not rare where the disforestation of flourishing plantations has been considered necessary in order to deprive the black-coated gentry of their zenana-khanas and nurseries.

They too often make themselves intolerable to the cultivators, and even a keen forest officer cannot help sympathising with poor Panjabi Singh or Jack Burman, who, driven to despair and wrath, fires the forest home of his black enemies.

The poor chap is probably run in and punished, and the plague he tried to combat gets worse than ever, as a new and denser crop of grass springs up after the fire, which killed the trees, but did not destroy the grass roots. All the time, nothing is more easy than to catch every pig in even a large forest, and this is how it is done.

Select a nice quiet, retired spot to build your trap. The trap is built in the form of an oval, the longer diameter some 40 feet, the shorter some 30 feet in length. It is constructed of closely fitting palisades with the bark left on. They should be at least 2½ feet in the earth, 7 feet above ground, and sufficiently strong to stand the simultaneous charge of a score or more of pigs. The trap has two heavy sliding doors, exactly opposite each other. Experience has shown that this facilitates the catching immensely, as the old sows, which are the most suspicious, apparently feel safer between two open doors, and do not so frequently give the signal for a bolt. A side door on the same principle, ending in a funnel-shaped passage with another small outer door, serves to transfer the pigs into cages for transport. *Fig.* 1 is a ground plan of a pig trap, and *Fig.* 2 shows the construction of the sliding doors.

These sliding doors can be set in such a way that the pigs either catch themselves, which however is slow work, and only to be recommended when a few stray pigs are still to be caught, or the spring can be pulled off by a man, and the whole sounder may be trapped at once.

The pull-off is similarly constructed for either purpose. The wire, and the rope end holding up the sliding doors must run over large well-oiled wheels. Those rope ends terminate in a smooth iron ring, and the ring, when the doors are set for a catch, is hooked on to a smooth iron pin well driven home into a firm post, low down if it is intended that pigs shall catch themselves, out of their reach, if a pull-off by a trapper is contemplated. A lever is placed between the ring and the post, in form of a long stick, if the pigs have to let down the doors, in shape of a shorter board with a wire through it, when the pull-off is to be done by a man. The following sketch (*Fig.* 3)

NOT SPORT BUT A NECESSITY.

Fig. 1.

GROUND PLAN.

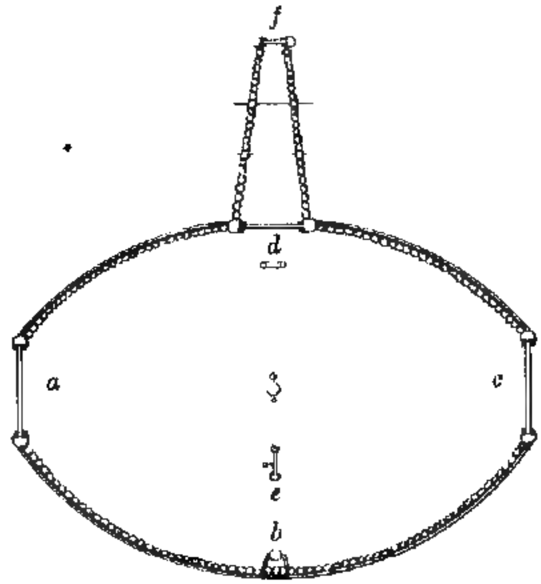


Fig. 2.

SLIDING DOOR.

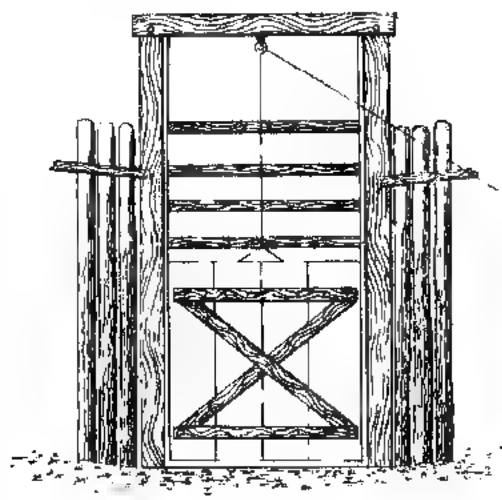
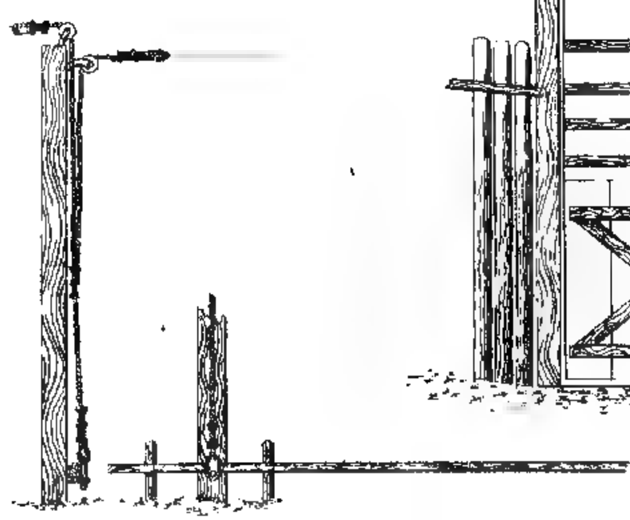


Fig. 3.

PULL OFF.



Litho. T. C. Press, Roorkee. THOS. D. BONA, *Supdt.*

will explain better than any description how the pull-off is constructed.

The next thing is to build two machāns, at a short distance of 30 to 40 yards from each side of the trap, to enable the trapper always to take up his position down wind.

The trap is now complete, and the business of seducing the pigs to enter begins. This may sound doubtful, but nothing is easier in practice, and pigs may be collected in it from miles around.

Trains of coarse grain, more or less continuous, are laid from different parts of the forest, all ending near the trap, where shallow trenches are dug and are constantly refilled with a small quantity of grain of sorts, which should be covered by a layer of a few inches of soil, in order to prevent deer from entering together with the pigs. The former would soon make a *tabula rasa* of the food, and the animals would disappear before daylight.

In less than a month the pigs become quite accustomed to the trap, and in a very short time, to the trapper as well, who ought to be near the trap, or in one of the machāns for another fortnight or so at the time of feeding.

Then comes the time for action. The trapper is early in his machān, and pulls off when a sufficient number of pigs have entered the trap. Hereafter the trap can be set for self-action, to get hold of solitary boars and any other pigs that may have been left. The pigs should not be killed in the trap, or near it. The trapping must be done by the man to whom the pigs have grown accustomed, and any bungling in the catching should be avoided, or future takes will be rendered infinitely more difficult.

Dogs should never be taken in or near the trap; they have not lost the habit of Lance's cur, and pigs object to this as much as ever did the Duke of Milan.

F. O. L.

MEASURING TIMBER BY HOPPUS' MEASURER.

PERMIT me to ask your learned readers, through the medium of your Journal, if the usual practice of measuring round logs of timber by Hoppus' measurer or by Candy's book in this circle, is not incorrect and based on erroneous principle. The usual formula made use of is solid content $= L\left(\frac{c}{4}\right)^2$, where $L =$ length, and c is the perimeter of mid-section, $\frac{c^2}{4}$ is the correct mean sectional area, when c is the sum of the four sides of the square, that is, the log is of square section; but if it be circular,

the correct sectional area is $\frac{c^2}{4\pi}$, and if $\pi = 8{\cdot}1416$, it is $= \frac{c^2}{12{\cdot}5664}$, which is decidedly much more than $\frac{c^2}{16}$. Mr. Mein in Vol. XI., No. 8, page 376, has published a table, in which he calculates the cubic content by the same inaccurate method. From the measurement it is plain that the logs are resembling the frustum of a cone, the true formula for which $\{L\,(A + A_1 + \sqrt{A_1\,A})\}$ would of course be difficult to use in practice, but for fair approximation they may be assumed to be the frustum of a cylinder, the formula may be applied is L $\left(\frac{c^2}{4\pi}\right)$. You will see that by this method the content amounts to 14′ 11″ 5‴ instead of 11′ 7″ 4‴.

Bombay S. C. DIFFICULTY.

INFLORESCENCE OF DEODAR.

I SEND you ripe seeds of deodar from a tree marked last year, and from which young cones were taken at end of August 1884; this proves that from the time of impregnation by the pollen, (1st week in October 1884,) not more than 12 months elapses for deodar seed to ripen, and from birth of cone (about 15th August) 13½ to 14 months. I also send three new cones from the same tree, showing that at any rate for two successive years cones are found.

J. C. McD.

SQUIRRELS EATING TEAK SEED.

THERE are three teak trees in my compound which have blossomed freely every year since 1881, but I do not remember ever obtaining any mature seed from them, and the reason for this I discovered a few days ago, as I noticed one of the brown striped squirrels, which are so numerous in Dehra Dún, climbing from twig to twig, in the crown of one of the trees, and eating off the soft and unripe fruits one by one, so that there are now only a few visible here and there in the remains of the masses of inflorescence which cover the crowns of the trees.

W. R. F.

III. Official Paper.

AGRICULTURAL INSTRUCTION IN GERMANY.

There was no Agricultural School of the first class in Prussia before 1835. In 1819 an Agricultural Professorship was sanctioned for Bonn; but the appointment was not filled up. In 1835 a School was organised at Eldena in combination with the University at Greifswalde. The foundation of the School at Poppelsdorf, near Bonn, took place only between 1813 and April 1847. At that time the organisation of the School was considered sufficiently complete to formally open it. At present the Kingdom of Prussia contains two High Schools of Forestry, 7 for Agriculture, and 3 for Veterinary sciences. The Kingdom contains next 16 schools for Agriculture of the second class and 54 of the third class; also 4 schools of Pomology and Spade Culture. Besides these regular schools, there are 64 winter schools and travelling instructors chiefly concerned with agricultural specialities.

2. There are 29 experimental stations of the first class, the main occupation of which consists in the control over manure, seed, and fodder. They have each a first class laboratory, and carry out constant scientific experiments and researches, not only in these, but in all other branches of agriculture, concerning life, nutrition, propagation, &c., of animals and plants.

3. Prussia contains some 1,700 societies connected with agriculture, bee-culture, cattle and horse breeding, &c. The greater number of these societies are centralised in Provincial Societies, and again represented in Berlin by a General Council for the Empire, which takes note of anything which occurs of general interest to agriculture, be it in the way of new discoveries, or legal proposals, or otherwise. The Council is perfectly independent of Government.

4. The teaching at the High Schools of Agriculture is divided into three main branches :—

(a). Chemistry and Physiology.
(b). Technics.
(c). Political Economy.

The following is the programme of the Agricultural School at Poppelsdorf :—

I.—*Introduction to agricultural studies*—

Encyclopædia, Methodologie, History and Literature of Agriculture.

II.—*Natural Sciences*—

1. Mineralogy and Geognosy.
2. Botany and diseases of plants.
3. Zoology, with special reference to the anatomy of domestic animals.
4. Physics (theoretical and practical).
5. Chemistry " "
6. Physiology " "
   (*a*), of plants,
   (*b*), of animals,
   (*c*), specially of domestic mammalia.
7. Agricultural Chemistry—
   (*a*). Nutrition of plants and manuring.
   (*b*). Characteristics and value of fodder, with special reference to fodder mixture.
   (*c*). Chemistry and Physics of plants.
   (*d*). Ditto of animals.

III.—*Mechanics*—

(1). Surveying.
(2). Mechanics, and knowledge of agricultural instruments and their construction.
(3). Buildings and communications.
(4). Draining and irrigation.
(5). Drawing.

IV.—*Political Economy and Law*—

V.—*Agricultural technics* —

(1). Fields and plants.
(2). Cattle and live stock.
(3). General management.

(1) is sub-divided into—
   (*a*). Amelioration of lands and estates.
   (*b*). Of soils, manuring, treatment of soils, special culture (practical experiments).
   (*c*). Use of agricultural instruments in practice.
   (*d*). Pomology—vine and vegetable growing.

(2) is sub-divided into—
   (*a*). General or breeding.
   (*b*). Specialities—horse-breeding, cattle-breeding, sheep, with special reference to wool, small animals, &c., bees.
   (*c*). Sanitation for domestic animals.
   (*d*). Accouchements and shoeing.

(*e*). Hurts and external diseases of animals; also epidemical and acute diseases.

(3) is sub-divided into—

(*a*). General management.
(*b*). Valuation of estates.
(*c*). Organisation of management, and budgetting.
(*d*). Agricultural book-keeping.

4th August, 1885. B. RIBBENTROP.

THE following table showing age of sleepers on different lines of Railway, is extracted from the Statistics of Indian Railways for the half year ending 31st December, 1884:—

Railway.	Average Age of Sleepers.		Percentage of Renewals.	
	Wood.	Iron.	Wood.	Iron.
	Years.	Years.	Per cent.	Per cent.
East Indian, ...	6·0		3 85	1·88
Madras, ...	7 0	15·0	7·75	0·13
Great Indian Peninsula, ...	(*a*)	(*a*)	6 30	1·28
Bombay, Baroda and Central India,	12·0	10·0	7·18	0·60
Scinde, Punjab and Delhi, ...	12·0	12·0	10·69	0·33
Oudh and Rohilkhand, ...	12·0	11 0	1·19	0·50
Punjab Northern, ...	3·0	...	0·83	...
Indus Valley, ...	6·0	6·0	0 48	0·47
Eastern Bengal, ...	...	...	...	...
H. H. the Nizam's, ...	11·0	11·0	3·10	0·001
South Indian, ...	9·5	17·0	1·40	...
Rajputana-Malwa, ...	5·0	2·0	2·47	0·18
Northern Bengal, ...	6·0	3·0	8·69	0·04
Tirhoot, ...	5·5	1·5	5·19	0·09
Cawnpore-Achnera, ...	3·0		0·08	
Nagpur-Chhattisgarh, ...	3·5	...	3·5	...
Burmah, ...	6·0	...	0·80	...
Bhavnagar-Gondal, ...	4·5	...	0·001	...
Mysore, ...	3·50	...	0·01	...

(*a*) Information not available.

IV. Notes, Queries and Extracts.

Forests and Forestry in the Nizam's Dominions.—In His Highness' Dominions, which of course include the Hyderabad Assigned Districts, there are no "high forests" similar to what may be found on the Western Ghâts in the Districts of North and South Canara: there, one might walk for almost hours together without ever seeing the sky. In the Nizam's territory the best jungles are to be found near Chiculda on the Gawilghar range of hills to the extreme north of the Assigned Districts; and also in the talúks of Mahadapur, Pakhal, Kundiconda, Khummum-mett, Muddra, and Palúncha in the Elgundel and Khummum zillahs, and in the jungles in the neighbourhood of Nirmul, Mahúr, Sindkeir and Edlabad in the Indore zillah. In these, timber of large size is still to be got, but felling has been carried on to such an extent, and natural reproduction has been so impeded by annual recurring fires, that the forests are becoming exhausted, and the day is not far distant when all cutting will have to be prohibited and the forests given complete rest. To the west of the territory the jungle is little better than scrub.

The most useful timber and that which brings in the largest income is teak, this is sold both in the log and as tapering poles; these last are classified as first, second and third sorts, and are used in immense numbers each year as rafters for buildings, &c. The first sort measure 15 to 18 inches in circumference at the thickest part of the "bole," and are priced at H. S. Rs. 10 per 100: the second sort, 9 to 15 inches, bring in H. S. Rs. 8, and the third sort, 6 to 9 inches, H. S. Rs. 4 per 100; the purchaser paying all costs of felling and carting. Teak, bijasal, and bhútunkús (the devil tree) are sold by the piece, pieces of different dimensions having different names, such as "mahawunt," which represents a large beam, and by nine regular gradations, down to a "bunjara-kari" which measures $12' \times 4\frac{1}{2}'' \times 1\frac{1}{2}''$. Hitherto there has been great laxity in the classification of timber, but recently the Conservator has drawn up a new scale correcting the defects in the former system and pricing it per cubic foot. The three descriptions of wood above mentioned were priced at an average of 8 annas per cubic foot: ebony, satin and sheeshum at Re. 1 per cubic foot, and nulla-muddi (*Terminalia tomentosa*) and that splendid wood anjun or "Eppa" (*Hardwickia binata*) at 5 annas per cubic foot. It was only within the last three years that these

two last-named trees were included in the prohibited list: up to that time they had been included in the list of inferior trees, and were cut down indiscriminately by the lessees of the inferior timber jungles. The rates now charged for timber are greatly in excess of those which prevailed formerly; but those were ridiculously low and permitted an excessive profit being made by the timber merchant to the detriment of the interests of the Nizam's Government. It is fully expected that a determined effort will be made by those whose profits have been lessened, to get the rates reduced by with-holding tenders and thus *starving* the Government into submission, but the Forest Department can afford to stand a siege, and *rest* will be of incalculable benefit to the forests which have been so depleted, as to be threatened almost with extinction.

The finest teak is found near the Godavery, south of Mahadapúr, at an elevation above sea-level of 600 to 700 feet; and the worst-grown teak, near the railway line on the Gungawaram ghât at an elevation of over 2,000 feet; which would seem to show that high elevation is not suitable for this tree. The finest "anjun" is to be found near Kulloor in the Madra talúk, and magnificent specimens of "abnús" (black-wood) are to be found in the jungle south of the Pakhal lake. That giant grass the bamboo (*Dendrocalamus strictus*) grows more or less over the Northern, Eastern and Southern Districts, but it attains the greatest perfection in the Palancha zillah. This article of forest produce is still, as formerly, leased *en bloc*, but the system is open to many objections; its *only* recommendation being simplicity. A change is contemplated. Space precludes us from alluding any further to the forests in the Nizam's Dominions beyond saying that their area is still unknown: we believe a rough traverse is contemplated with a view of affording this information.

We will now say a few words on forestry, by which we mean the system adopted for conserving the jungles and working them so that they may not become exhausted, and that the Government may derive the greatest possible benefit from them. The system in vogue is far from satisfactory, and the blots in it may be summed up in two sentences: dual ownership, and over-centralization. Remove these blots and a decided step will have been taken towards introducing a new and better system. At present, while the superior timber in any jungle is under the care of the Forest Department, the inferior timber in the *same* jungle is under the Revenue Department, who lease out this portion each year, by auction, to the highest bidder: there is no limit whatever to the timber the lessee may fell so long as he avoids the prohibited descriptions, and as a result that the wastage is incalculable.

As no powers have been given to the assistants as regards selling timber, all sales must be sanctioned from the head office;

thus, great delay is entailed, and, rather than wait, many merchants supply their wants either from British territory or from private jungles. Before however extended powers are given to subordinates, from Darogahs downwards, a new check system must be introduced, or it is feared peculation will greatly increase. The Darogahs themselves should be men of a far superior stamp to those at present employed: some of these have been in the Forest Department from its commencement and (*miserabile dictu*) one or two of them can barely sign their names in any language. As vacancies occur they should be filled with men of some education: able to read and write, conversant with square and cubical measurements, and qualified to conduct a simple survey with compass and chain: preference to be given to men who know English. Some greatly improved system is also required in the issuing of licenses and passes for duty-paid timber and forest-produce. We commend our remarks to the earnest consideration of the Inspector-General of Revenue, and we trust that he may be able to evolve a scheme which may be creditable to himself and a lasting benefit to the Nizam's State.

We now propose to touch upon two subjects only, "Reserves" and "Nursery Plantations." The only *real* reserved jungle in His Highness' Dominions is situated north-west of the station of Dharur. It comprises about six square miles, and is fairly stocked with wood suitable for engine fuel. This reserve was selected by Major Mead, Engineer-in-Chief of the Nizam's State Railway, which was at that time (1873-74) under construction, and was intended solely for the supply of wood fuel. A survey was made and the selected area enclosed by a ditch. No fuel was drawn from it till the years 1880-81, when 15,000 to 20,000 tons were taken out. The reserve was then closed and, for the first time, all cattle were excluded; now after a lapse of four years' natural reproduction, it has progressed sufficiently to admit of its being partially worked again. The reserve has had two formidable enemies to contend against: the grazing by goats and fire. Of all quadrupeds, goats are most dreaded by the Forester; cows, bullocks, donkeys, horses are all bad enough, in their way, but the destruction wrought by them is not to be compared to that caused by goats, who wantonly nip off the top of every tender seedling they come across. The proximity of the railway is a source of danger; sparks from passing trains have been known to set on fire the grass close to the line, and from there it has spread into the reserve. By clearing 100 feet between the railway fence and the jungle, it is endeavoured now to minimise the risk. The grass in the reserve is of a coarse, rank description, and, when fired, burns with great energy, leaving its mark on the stems of trees 20 feet from the ground. It is in contemplation to make a *strict* reserve of the Muddulpully jungle, on the Anantagherry Range, about six

miles to the north-west of Gungawaram. This is, at present, being worked for wood fuel, and is splendidly stocked with timber.

The only "Nursery" extant is about two miles north of the Dharur railway station, and is situated just outside the reserve. The site was selected by Captain Gaignoux, who at that time was in charge of the "Railway Fuel Sub-Division." The site is badly chosen, being on poor soil, greatly exposed to prevailing winds, and scarce of water. Through the indefatigable energy, however, of the officer who for the last few years has been in charge, the results have been fairly satisfactory. Besides indigenous seeds, Jamaica was laid under contribution for mahogany; Canada for the butter-nut, the hickory, and other species too numerous to mention; Bangalore for the jack, the casuarina, &c.; the Horticultural Gardens at Saháranpur for ornamental trees, like the *Grevillia robusta*, *Ceara* rubber, &c.; and the result is that the outturn of the whole, in spite of draw-backs, presents a very fair appearance. The fastest growing tree in the garden is the *Eucalyptus*, of which there are about a dozen species (this family it is believed numbers about 700 varieties!) Some of these trees, in three to four years, have grown 40 to 50 feet high. The handsomest tree in the garden is the "India rubber," and next to it is the *Grevillia robusta*. The Government of India, through the Resident, sent a supply of "carob" seed for experiment. After failure, from sowing in unsuitable soil, success was attained, and there are now several healthy plants 6 to 7 feet high: this seed failed to germinate in the Central Provinces. A number of carobs, and seedlings of other trees, to the number of 3,000, have been transported to Sùrúnagar, where they have found an honoured resting place in the park attached to His Highness' new palace now under construction. The other trees and plants in the "Nursery" include sandal, tún, sirris, red-wood, mulberry, sissú, the rain-tree, Nagpore orange, Lucknow guava, *Hæmatoxylon campechianum* and mangoes; these last have failed miserably, growing some of them to a height of 6 to 8 feet and then coming to a stand-still.

Although we are conscious that we have left many points untouched upon, we must now draw our short sketch to a close, and will trust that the light we have let in on the Nizam's forests (it is well-known that trees always suffer from *darkness!*) will be productive of benefit to that Department.—*Deccan Herald.*

M. CAMBRELENT, Inspector of Public Works, has made a report to the Agricultural Society of France on the subject of the dunes in the *landes* of Gascony. These sand-hills cover a surface of more than 85,000 hectares; they are more than 80 me-

tres high and 5 to 6 kilometres wide. Before a method of arresting these was discovered they were being constantly pushed inland by the winds, invading and covering fields, villages, and even burying churches up to their towers. In 1780 Brémontier sought to render them immoveable by planting them, after many experiments designed to develop a primary vegetation. His work has been continued with perseverance, and it is only recently that it has been completed, and these 85,000 hectares, which menaced all the country adjoining, have become covered with a rich forest vegetation which has fixed the dunes in one place. A great public danger has been converted into a large forest. But this work, which renders permanent, dunes already existing, has not prevented the sea from throwing up on the coast new sand day by day, which forms dunes, which in their turn invade the permanent dunes. After having fixed the old sandhills, the problem was to prevent the formation of new ones. To solve this it was decided to construct a dune above high water, in which all the conditions of the moveable dunes would be reversed. The form given to the latter by the wind is such that on the side of the sea they present a gentle slope, which the sand can mount easily as on an inclined plane, in order to fall down a steep decline. It is by the gentle slopes forming a series of inclined planes that the sand moves forward. The formation of the new dune was encouraged, but it was directed in such a manner that it had a steep slope on the side of the sea. To secure this a wooden palisade was erected about 120 metres away from the sea, all along the shore. The sand first struck against this in its progress, and fell at its foot, a portion of it escaping through the interstices left between the planks. The latter was carried some distance by the force of the wind, and fell, forming slight slopes, while the sand which fell at the foot of the palisade on the side near the sea formed a steep incline. Soon this reached the top of the palisade, and then the planks were drawn up by means of a special implement to the needed height, and the formation continued as before, the slope on the side of the sea growing steeper, while the other got more and more gentle. Ultimately the dune reaches such a height (generally 10 to 12 metres) that the sand can no longer get over it, and it is definitely arrested between the barrier and the sea. It falls back on the shore, unable to advance, until contrary winds come and blow it out to sea again. To fix the sand on the other side of the barrier, the *Arundo arenaria* is planted. The roots penetrate to a depth of 4 or 5 metres, and the plant always keeps its head above the increasing sand. The results obtained by this new dune (says M. Chambrelent) have been complete. The most violent storms have not been able to carry the sand over it; the latter has fallen back on the shore innocuous, and the advance of the inexhaustible sand coming from the sea has been absolutely arrested.—*Nature.*

EFFECTS OF THE CUTTING OF FORESTS ON WATER SUPPLY OF RIVERS.—Upon the territory of the commune of Labrugniere (a village of France) there is the forest of Montant, containing 4,524 acres, and owned by the commune. At the entrance of the forest, and along this brook, will be found several fulling mills, each requiring eight horse-power, and moved by water wheels which work the belters of the machines. The commune of Labrugniere had long been noted for its opposition to the forest regulations, and the cutting of wood, together with the abuse of pasturage, had converted the forest into an immense waste, so that this great property would hardly pay cost of guarding it, and afford a meagre supply of wood for its inhabitants. While the forest was thus ruined and the soil denuded, the waters after each heavy rain swept down through the valley, bringing with them great quantities of gravel, the *débris* of which still encumber the channel of the stream. The violence of these floods was sometimes so great that they were compelled to stop the machines for some time. But in the summer time another inconvenience made its appearance. Little by little the drought extended, the flow of waters became insignificant, the mills stood idle, or could run only occasionally for a short time.

About 1840 the municipal authorities began to inform their population relative to their true interests, and under the protection of better supervision the work of replanting has been well managed, and the forest is to-day in successful growth. In proportion as the re-planting progressed, the precarious use of the mills ceased, and the regulation of the water-courses was totally modified. They now no longer swell into sudden and violent floods, compelling the machines to stop; but the rise did not begin until six or eight hours after the rains began, they rose steadily to their maximum, and then subsided in the same manner. In short, they were no longer obliged to stop work, and the waters were always enough to run two machines and sometimes three. This example is remarkable in this, that all the other circumstances had remained the same, and therefore, we could only attribute to the reforesting the changes that occurred, namely, diminution of the flood at the time of rain and an increase in its flow during common times.—M. CANTEGRIL, *Sub-Inspector of Forests, in Ami des Sciences.*

PLANTS UNDER TREES.—We have been asked recently to name a section of plants that could be planted under trees. We could name several, such as hollies, privet, euonymus, box, berberis, &c., with something like a preference for the latter. In berberis we get a genus of shrub possessing the highest qualifications for purposes of ornament; and all the grander evergreen species do better under trees than in the open; in fact, they require to be constantly in the shade. The soil in which these thrive best is

a deep, rich, moist, sandy loam, with abundance of water overhead and at the roots. Among the species the noblest of all is *Berberis mahonia japonica*, which for magnificence of foliage has no equal among hardy shrubs. It naturally grows in the form of a dense bush, with large pinnated leaves of hard texture and of a lively green hue. Specimens of it are now covered with spikes of flower-buds, which will open at the first break of spring weather, and soon be succeeded by bunches of grape-like berries, covered with a lovely bloom. Two other noble, large-leaved species which thrive under trees are *M. Bealii* and *M. intermedia.* For warm, sheltered gardens, *M. Nepaenus* is most beautiful, and *B. Fortune* is well worth having, but both these are rather tender. One of the loveliest of flowering shrubs is *B. Darwinii*, which blooms abundantly, and of which we have had spikes of bloom sent us on Christmas Day from Devonshire. One of the cheapest for common purposes, and a really beautiful species, though not equal to those already named, is *M. aquifolium*, well adapted to plant in quantity in town gardens, and to form game covers or belts for screening off the compost or rubbish yard from the kitchen garden. These are certainly the best for planting under trees.—*Land and Water.*

AMONGST the recent arrivals we notice a sample parcel of Cape boxwood,* delivered at the West India dock per *Warwick Castle*, consisting of 55 pieces, weighing nearly three tons. The logs are of good sizes, sound and clean grown. This wood possesses a closeness of grain almost equal to the best Abassian boxwood, and it is thought will suit admirably for engravers' purposes. From the specimens of this wood, and engravings printed from it, which were shown at the Forestry Exhibition at Edinburgh last year, it would appear to be one of the best hardwoods yet put forward as a substitute to supply the demand for the ever-diminishing supply of boxwood.—*Timber Trades Journal.*

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* Mr. Hutchins will perhaps kindly report the scientific name of this tree.—[ED.].

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FOREST ORGANIZATION FOR BEGINNERS.

(*Continued from page 529*).

SECTION II. DIFFERENTIATION.

CHAPTER III.—FORMATION OF COMPARTMENTS, SUB-COMPARTMENTS AND RANGES.

WHEN a map showing the boundaries and principal features of the land has been made, the forest should be divided into a number of compartments by means of a system of rides, or by natural divisions, or both.

It is evident that to estimate the quantity of standing-stock on a large area, would be very difficult if the forest consisted of groups of different ages, density, or species: small portions (compartments) must, therefore, be dealt with separately, and demarcated by means of rides, &c., so as to be easily distinguished on the ground and on the map. Another reason for this procedure is that, without lines of separation, it would be extremely difficult to fix the position of each group. Rides are also very useful as a protection from fire, because if the grass on them be burnt just before the hot weather, a fire breaking out in the forest on one side of the ride might be arrested by it, and the forest on the other side saved. Again, trees which have grown up in thick cover cannot, after a certain age, be exposed to sun and wind with impunity; they are apt to lose their bark, to get what is called sunstroke, and to be uprooted by wind; but the formation of rides enables trees on their edge to grow up vigorously, to throw out numerous branches and roots, and to get a firm hold of the soil, which trees growing in dense cover cannot have; it accustoms them, in short to the exposed situation, so that, even if the groups in the compartment in front be cut away, they are able to withstand and break the force of the wind, thereby protecting the more weakly trees behind, which could not otherwise resist the storm. Another

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advantage of having rides is that a coupe* may be located almost anywhere, whereas, if there were no rides it might, and generally would be necessary in seedling-forests,† to commence cutting at one end, and to work steadily through from the fair-weather quarter to the stormy quarter of the compass, in order that the forest in front should protect the portions suddenly exposed by the cutting, and those in process of regeneration; and if immature groups were met with, they would have to be sacrificed in their turn in order to ensure a proper sequence of coupes. Finally, rides are often very useful as export-roads: as open places for stacking and drying the material collected for sale: and in facilitating the inspection, regeneration and cutting of groups.

To recapitulate—the object of forming compartments and separating them by means of rides is briefly this:—to facilitate the survey of interior details and the estimate of standing-stock: to ensure the carrying-out of a regular system of cuttings and regeneration, which would be impossible in forests not so parcelled out, to avoid the evil effects of suddenly exposing trees, which have grown up in thick cover, to wind and sun: to afford protection from fire: to admit of freedom in locating coupes: to facilitate the regeneration of groups and the extraction of the produce: and to afford suitable places for collecting and drying it.

Rides are of two kinds—*main* and *minor*. The former, as already explained, must be made broad enough to admit of the trees on their edges throwing out vigorous roots and lower branches, and thus forming a protective fringe against wind. Minor rides may be made much narrower, their primary object being the division of the forest between two main-rides into compartments of convenient size. Sometimes, however, they are used as fire-traces, and have to be made as broad as main-rides.

The width of main-rides depends on the station, kinds of tree, and régime. In high-lying, exposed localities, subject to violent storms, their width has to be made greater than is necessary in sheltered parts of the country. Again, seedling-forests subject to long revolutions require broader rides than those subject to shorter revolutions, or than coppice, in which there is generally nothing to fear from wind; and trees whose roots do not penetrate far into the soil require greater protection than trees which are more deeply rooted. 15 to 60 feet may be taken as limits, and it may be assumed in a general way that

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* A *coupe* is a term used to denote any area on which a cutting is carried out.

† The term *seedling-forest* is applied to any group which has originated from seed, in contradistinction to the term *coppice*, which is applied to groups originating from the shoots of tree-stumps, or from suckers. The term *high forest* is very often used instead of *seedling-forest*, but that is quite a misnomer, as the forest may be cut down long before it attains to any considerable height, and in its earlier stages it is necessarily low.

a breadth of 15 feet will suffice for coppice, and of 45 feet for seedling-forest. When intended to serve as a protection from fire, rides should seldom be made less than 60 feet broad, and will often have to be made much broader: the breadth will then depend mainly on the kind and density of the jungle; if the cover is good, there will be little or no grass, and 45 feet may suffice, but in open jungle with long grass a breadth of at least 60 feet is necessary.

Minor rides need not exceed 8 feet in breadth, provided they are not required for cart-traffic, nor fire-traces.

In flat, or gently undulating country, the best plan is to have a regular network, the main-rides running parallel to each other, and in the direction usually taken by heavy storms, and the minor rides joining them at right angles. The distance apart of the former should not be too great to admit of a cutting being made along the whole length of the minor ride connecting two main-rides. The forest will then be divided into a number of parallelograms, or other figures (compartments), whose size will depend on the station,* topographical features, such as roads and streams, which may be conveniently used in place of rides, and on the kind and age of the trees inclosed. It is well to separate lands differing considerably in productiveness, and groups differing greatly in age, at the same time not forgetting that very large compartments are inconvenient, and that very small ones necessitate a great deal of land, taken from the productive area, being turned into unproductive rides. Experience teaches that compartments of 25 to 75, or at most 100, acres are the most convenient for administrative purposes, but for the sake of economy it may often be found necessary to exceed considerably that maximum. In determining their position and extent, it is well to bear in mind that it is important to separate portions of forest which are likely to differ permanently, so that differences of station should be the chief consideration; differences that may be more of a temporary nature, such as differences of species, age, or density, are of much less importance, because in course of time it will generally be possible, if necessary, to bring about uniformity in these respects if the station itself is tolerably uniform. The sides of a compartment which are bounded by main rides should, if possible, be about twice as long as those adjoining its minor rides, as it is found that the most convenient shape for administrative purposes is thus obtained.

The object of having the broad rides running in the direction generally taken by heavy storms, is of course to afford protection to the cuttings and young growth by means of the forest in front. In mountainous country it is desirable

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* The term *station* is used to denote the three factors on which the growth of a group naturally depends, *viz.*, soil, climate and situation.

that they should follow the configuration of the ground, *i.e.*, that they should be as nearly horizontal as is convenient, so that they may be useful for the transport of produce. Roads, when not too sinuous, make the best boundaries of compartments, and the system of export roads should, therefore, be determined on before the compartments are marked out. Natural boundaries, such as streams, valleys, ridges, afford natural divides, and should be utilised in laying out lines of separation for compartments and blocks.

The portion of forest lying between any two main-rides (or their substitutes) is called a *block*.

The whole system of rides should be pegged out on the ground, and marked on the map in pencil before any are opened out; or it may be necessary to cut very narrow lanes in the forest; any alterations can then be easily made if it is discovered as the work progresses that changes are necessary: such narrow passages are of no consequence when they have to be abandoned, but of course the case would be very different if rides were opened out to their full width and afterwards abandoned.

The accompanying sketch (*Fig.* 1) represents a hill forest with main rides following the configuration of the ground, which is shown by means of contour-lines. The stormy quarter is on the left, and the cuttings of groups in a compartment march in the main from east to west, in the direction indicated by the arrows.

Minor rides are often practically main rides. Those in the sketch, for example, which separate compartment 10 from compartment 11, and 9 from 12, ought to be as wide as the main rides if the flanks of the compartments are to be properly protected.

As a rule, as soon as the position of rides has been definitively settled, they should be opened out to their full extent, and all stumps and roots eradicated. Sometimes, however, it is dangerous to open out new rides running through seedling forest, to their full width. This may be the case when a ride is taken through a densely stocked group which has got beyond the thicket stage and attained to a fair height. The trees will then be lanky and weak, and, if a broad ride were suddenly cut through them, a storm might get into the group and cause great havoc by uprooting and breaking a number of trees. In such cases it is advisable to open out the line gradually, or it may be opened to the breadth of a few feet only, and so left until the forest is regenerated, when the ride can be enlarged without danger.

Very large areas have to be split up into smaller units, called *ranges*, each one being in charge of a ranger, or manager, and distinctly marked off from the others by natural or artificial boundaries. Their size depends upon the extent of forest which can be efficiently managed by one official. No general rules

can, however, be laid down. Special circumstances, such as the kind and quantity of work to be done and the situation and value of the forest, must decide the matter. A forest, for instance, producing a large crop of minor produce, as well as timber and firewood, would generally require smaller ranges than one yielding only firewood. Generally speaking, forests worked intensively, that is, those in which a comparatively large capital is locked up, require smaller ranges than those which require a comparatively small outlay for their maintenance. Take, for instance, the case of a range yielding timber, firewood and valuable minor produce, and that of one simply producing firewood-coppice. Area for area, there would be a much larger capital required for working the timber-forests, in which there would be a valuable standing-stock and crop of minor produce, an establishment for guarding the latter, and for collecting, drying, and storing it, in addition to a large protective establishment for the forest generally. In the case of the range yielding only firewood, the standing-stock would be of little value, comparatively speaking; the expenditure for guards would be small, and there would be no outlay at all on account of minor produce. Evidently, a ranger could manage a much larger extent of the coppice than of the other forest with its numerous staff and accounts.

To enable foresters and workmen to find the compartments easily, roughly cut, small, numbered stones standing out 15 inches above ground, or, where stone is not available, wooden posts, should be erected at points where rides meet, and also at intermediate points in rides which are very long. The distance between these stones should not, as a rule, exceed two hundred yards. Where the expense of putting up stones or posts is too great, or where there is fear of posts being burnt by ground-fires, it will often be found possible to throw up mounds of earth or stones, or to have the more durable kinds of mark at the corners, and the less durable at intermediate points. They should be erected on the sides of rides, not in the centre, where they are more liable to be damaged and may interfere with traffic, and all should be on the same side of the rides, either on the right or left, so that they may be easily found. The numbers should be cut on the stone, and may be painted over to make them more easily distinguished.

All ride-stones and their numbers, as well as those of compartments, should be shown on the working-map, but may be omitted on inspection-maps, which are too small for such details.

When the organiser finds that the forest has already been split up into blocks, he should accept, as far as possible, existing sub-divisions, only making such additions and alterations as appear to him absolutely necessary.

Groups in the same compartment have to be separated from one another by some inexpensive means, such as wooden posts,

small mounds of earth or stones, or by narrow cleared lines. Such boundaries are shown on the detail-map by means of dotted lines, and the area occupied by each group is called a *sub-compartment*. Each sub-compartment is known by a letter of the alphabet with the number of the compartment prefixed: thus, 5 *a* is sub-compartment *a* of compartment 5 (*see Fig.* 2). Groups occupying an area of less than an acre need not be separated.

SECTION III. ASSESSMENT.

The organizer is now in possession of a forest which has been divided into compartments and sub-compartments, and he may, therefore, proceed to the assessment of groups, that is to say, to a description of their station, and an estimate of their age, height, quantity, value and rate of growth; but before entering into this part of the subject, it will be necessary to devote a chapter to a description of the instruments which are mostly employed in the assessment of groups.

CHAPTER IV.—INSTRUMENTS REQUIRED.

Besides the ordinary surveying tools, instruments are required for measuring the diameters or circumferences of trees, and their heights, and for estimating the cubic contents of wood of irregular form, which cannot be directly measured.

DIAMETER AND CIRCUMFERENCE MEASURES.

One of the best forms of diameter-measure is the one shown in the accompanying diagram (*Fig.* 3). The arms AB, CD, are made of well-seasoned teak or oak. The limb EF is fixed at right angles to AB at E, and slides through an aperture in CD. The limb GH is fixed at right angles to CD, and fixed to CD at G, sliding through an aperture in AB. GH is made to run along a V-shaped rail on EF to prevent the limbs from separating when one is drawn out beyond the aperture in CD or AB. The limb EF is divided from the point E into inches and fractions of an inch, the divisions being numbered from E to F, and continued along the lower limb from G to H; thus, if from E to F is 24 inches, the first inch on GH would be marked at the end near G, and be numbered 25. In using the instrument, it is grasped by the handles at B and D, and its arms are placed so that the trunk to be measured shall be between them. B and D are then pressed towards each other until both arms are resting against the tree; the diameter is then read off on the limb EF, or GH, as the case may be. This is a very handy and portable instrument. Its dimensions depend on the size of the trees to be measured. With arms and limbs 3 feet long, trees up to 5 feet in diameter may be conveniently measured.

For measuring circumferences an ordinary tape, or one of steel or leather, is used.

Trees can be measured much more expeditiously with the diameter-measure than with the tape; the latter may, perhaps be slightly more accurate for *single* trees, but even that is doubtful, and, anyhow, whatever slight advantage is gained in this respect, is more than counterbalanced by the comparative slowness of the process. When many trees have to be measured, the advantage of greater accuracy probably lies in favour of employing the diameter-measure. When the bole is very elliptical, it may be measured in the directions of the major and minor axes, and the mean of the two readings taken. Some foresters recommend that masses of forest should be measured with the diameter-measure, but single trees, such as sample-trees, with the tape; others, on the other hand, think the tape should be discarded altogether.

In measuring trees, allowance must be made for the thickness of the bark. This must be estimated for each diameter-class, and deducted after all measurements have been made in the field.

Height-Measures.

Many methods of estimating the quantity of standing-stock involve the use of instruments for measuring the height of standing trees. A theodolite is an excellent instrument for this purpose, but is troublesome to carry about, and its use takes up too much time to admit of its being generally adopted. The process of finding the height of trees with one is simple. Let CD, *Fig.* 4, be a tree whose height is to be measured. Set up the theodolite anywhere, at A, if possible, at a distance from the tree equal to about the height of the tree. Measure the angles BAC, BAD, and the horizontal distance (a) from A to the foot of the tree, D, along the ground, *making allowance for its not being horizontal, if necessary.* (a) will be equal to AB, and the height, H, of the tree will be found by the formula

$$H = (\tan BAC + \tan BAD)\, AB,$$

or since the measured length, $a = AB$,

$$H = (\tan BAC + \tan BAD)\, a.$$

If the theodolite is below the foot of the tree

$$H = (\tan BAC - \tan BAD)\, a. \quad (Fig.\ 5).$$

If the theodolite and the foot of the tree are in the same horizontal plane, the angle BAD disappears, and the formula becomes

$$H = \tan BAC \times a.$$

The reflecting hypsometer, invented by a German forester, is a more generally-useful and a thoroughly-practical instrument. It consists of a rectangular board, ABCD, some 9 inches by 5

in size, whose lower edge, CD, is divided into 150 equal parts to the left of the centre of the slide, *k*, and 50 to the right of that point, as shown in *Fig.* 6. The slide is moveable up and down a groove in the board at right angles to CD, and kept in any required position by a spring placed in the groove behind it. The eye-piece, *n*, and the objective, *m* (consisting of a horse-hair wire), are fixed to the board, so that a straight line connecting them would be parallel to AB and CD. CEFH is a mirror, by means of which readings can be taken at the same time as observations. The pieces *m* and *n*, consisting of brass, and the mirror, which has a backing of tin or brass, turn on hinges, and can be laid back flat on the board, so as to pack up easily into a small case. On either side of the groove the distances from CD, on the same scale as the horizontal scale, are shown. The plumb-line, *p*, is fixed in the centre, and near one end of the slide. By raising or depressing the latter, which is fifty divisions of the scale in length, the distance of the point of suspension of the line from DC can be increased from 60 to 120, whilst by inverting the slide, so that the end marked I is above, and that marked II below, the distance can be reduced to 10.

To use the instrument, measure the *horizontal* distance, in feet or yards, of the observer from the tree. Set the slide at the same relative distance on the vertical scale ; then, looking though the eye-piece, align the top of the tree with the hair at *m*, allowing the plumb-line full play. As soon as the latter is at rest, the number which it intersects on the horizontal scale can be read off in the mirror, and indicates the height of the tree, in feet or yards, as the case may be, if the observer's eye is on the same level as the foot of the tree; otherwise, a further observation will have to be taken to the foot of the tree, the result being added or deducted from that already obtained, according as the eye of the observer is above or below the foot of the tree.

The rationale of this method is as follows :—In *Fig.* 7, let BD represent the tree, and A the hypsometer, on which *ac* represents the vertical, or, as it is called, distance-scale, and *bc* the horizontal, or so-called height-scale. Draw a horizontal line, AC, from the eye-piece, A, meeting the tree in a point, C. Then, since the tree grows vertically, ACB is a right angle ; *acb* is also a right angle, and the two angles are therefore equal. BC is parallel to *sb*, therefore A*sb* = ABC ; and A*s* being parallel to *bc*, *sbc* is also equal to A*sb* ; therefore *sbc* = ABC, and the triangles ABC and *abc* are similar ; and

$$BC : AC = bc : ac$$

but by construction AC is represented by *ac*, therefore BC is represented by *bc*.

In *Fig.* 8, it is also evident that the triangle ACD is similar to the triangle *acd*, and that, therefore,

$$CD : AC = cd : ac,$$

and that AC being represented by *ac* by construction, CD is represented by *cd;* but the whole length of the tree is equal to BC + CD, therefore it is represented by *bc* + *cd*.

When the observer's eye is below the foot of the tree, as in *Figs.* 9 and 10, it is evident that the height of the tree will be found by deducting CD from BC. The values of CD and BC may be found in the manner just described, the observation for BC being taken to the top of the tree, whilst that for DC is taken to its foot.

Apparatus for determining the Cubic Contents of Amorphous wood.

Firewood is generally, and small timber sometimes, sold in stacks or loads, the size of which may vary in different parts of a country, and the solid contents of which is sure to be different for different parts of a tree. A stack of stem-wood contains, for instance, more solid matter than a stack of the same dimensions containing branches of the same tree. Wood of very irregular shape or very small size cannot be directly measured; hence the necessity of finding out the solid contents of a standard stack for different descriptions of wood (stem, large branches, and spray, for instance), and for different species separately. The process of measuring the contents of amorphous wood is tedious, and it would be impossible to measure every stack. The average of a number of experiments is, therefore, generally taken as a standard for a species, and for a whole district or country. Thus, in the Grand Duchy of Hessen, the average percentage of solid wood for all species is fixed as follows:—

Description.	Solid contents of stack, cubic feet.	Dimensions of stack.	Remarks.
Split stem-wood over 5 inches in diameter,	70 per cent. of size of stack,	4 by 6 by 12 feet.	Wood sawn in 4 feet lengths and worked up at right angles to length of stack.
Unsplit, smooth, or straight, stem or branch wood, 2 to 5 inches in diameter,	60 per cent.	Do.	Do.
Split stumps, ..	50 per cent.	Do.	Branches 12 feet long and stacked in the direction of the length of the stack.
Small spray, ..	25½ per cent.	..	

The result depends greatly on the way in which the wood is stacked, and on the dimensions of the pieces. Uniformity in these respects must, therefore, be strictly observed. Stacks of crooked, knotty wood, although of the same size as smooth, straight wood, should be estimated separately.

The solid contents of amorphous wood may be determined by means of the apparatus shown in the accompanying figure (*Fig.* 11). A cylindrical vessel, A, about 4 feet high and 2 feet in diameter, communicates with a similar vessel, B, by means of a tube at C. A glass tube, *t*, communicates at the bottom of the vessel B with its interior, the water in which can be let off by means of the stop-cock, *k*. By means of a graduated metallic scale and the glass tube, the cubic contents of water in B can be read off. To graduate the scale, a vessel of exactly one cubic foot capacity is filled with water which is poured into B, which is placed in a vertical position. The water rises to the same height in the tube as it is in the vessel, and the height to which it rises indicates the distance on the scale corresponding to a cubic foot of water in the vessel. This distance is then divided into fifths or tenths, each one of which will correspond to the fifth or tenth part of a cubic foot of water. In this way the scale is graduated up to the top. By reducing the diameter of B to one foot, greater accuracy will be attained, and the vessel need not be made any higher. The vessels A and B may be made of wood, but block-tin or zinc is preferable for the latter.

To use the apparatus, place A and B in a horizontal position, fill the vessel A with water up to the spout *c*, and place the mouth of the tube so that water passing through it will run into the vessel B. Then completely submerge the wood to be measured in the vessel A. This may be most effectually done by means of a finely perforated zinc or block-tin lid, exactly fitting the interior of A. The consequence will be that the submerged wood will displace a quantity of water equal to its bulk, which will overflow and run into the vessel B, when its cubic contents can be read off on the scale. The operation should be quickly performed, as wood soon absorbs moisture if left standing in the water.

The following is a less troublesome method, if not quite as accurate as the preceding. The cubic contents and weight of an easily measured portion of a tree of the required species is accurately determined, and the weight of one cubic foot deduced from the result. The weight of a standard stack of amorphous wood is then ascertained, and its cubic contents deduced from the known weight of a cubic foot of the measured wood. The proportion that the solid contents bear to the dimensions of the stack can then easily be found. If, for example, we find that part of the bole of a freshly cut blackwood-tree, measuring 3·005 cubic feet, weighs 200 lbs., that freshly cut spray of the same species, which, when stacked, occupied a space $5' \times 5' \times 4' = 100$ cubic

feet, weighs 2,000 lbs., we would then have one cubic foot weighing 200 ÷ 3·005 = 66·639 lbs., consequently, 2,000 would be equivalent to 2,000 ÷ 66·639 = 30 cubic feet; but, by hypothesis, these 30 cubic feet of spray actually occupy, when stacked, a space of 100 cubic feet; therefore, a stack of such wood, under similar conditions, might be assumed to contain only $\frac{100}{30}$ of its space, or about 33 per cent.

(*To be continued.*)

THE INDIAN FOREST SURVEY AND FOREST SCHOOL.*

It is only in comparatively recent times that measures have been undertaken to preserve what remained of the great Indian forests. The first thing to do was to demarcate the tracts which were to be reserved, and to free them as far as possible from rights. The area now reserved is about 48,000 square miles, or about 5½ per cent. of the total area of British India, not including the Native States. The tracts demarcated owe their immunity from destruction either to the fact that they occupy ground which was, in the absence of communications, inaccessible, or which is much broken, or cannot be irrigated. They are situated either in the plains or on the low ranges of hills rising from them, or on the lower or middle slopes of the Himalayas up to an elevation of 8,000 or 9,000 feet above sea level. Although they include within their boundaries considerable areas which have been wholly or partially denuded of trees, the ground is generally speaking more or less densely covered with trees and jungle.

In former years accurate forest maps were not required, but the present system of management renders good maps indispensable, and in 1872 measures were taken to provide them. The Imperial Survey Department could not conveniently undertake the work, and it was consequently thought desirable to organise a special branch of the Forest Department to act under the control of the Surveyor General. This arrangement has worked most satisfactorily. The scale of the maps formed the subject of much discussion, but ultimately it was decided that the scale should usually be 4" = 1 mile for the most valuable forests, and 2" = 1 mile for those of less value. An establishment of Surveyors was then raised and trained. The first work undertaken was the survey of the forests of Dehra Dún, area about 573 square miles, the private lands of the district being surveyed at the same time by the Imperial Survey Department, and a

* By Major F. Bailey, R.E., F.R.G.S., Superintendent of Forest Surveys in India.

Abstract of two papers read before the British Association at Aberdeen on 10th and 11th September, 1885.

combined map of the whole country being thus produced. The next work was the survey of the Kumaon and Garhwál forests, area about 1,400 square miles; and the survey of an area of about 1,600 square miles in Haiderabad is now in progress. Altogether since 1872 about 3,000 square miles have been surveyed and mapped, mostly on the scale of 4″ = 1 mile. It will of course take a long time to work over the whole of the forest property, but detailed maps of the entire area are not urgently needed at the present time, since for forests in which simple protection can alone be attempted small-scale maps or sketch-maps will suffice for some years to come.

When the survey party takes the field, the officer in charge has command of a considerable number of men, with a large quantity of stores and equipment. He has to hire carts or camels, and march to the scene of the work. On arrival, each Native Surveyor is given a piece of work, four or five of them being grouped under one European Surveyor, and a computing office is established in some central position. When sufficient work of this kind has been done, or when the season is too far advanced for it to be continued, the party moves back to head quarters. If such work is not well controlled it is sure to show this in inferior quality, insufficient quantity, or high cost. The procedure must be varied according to circumstances, and it has to be considered how a map that will answer the purpose can be produced in the shortest time and at the smallest cost. The ground worked over by the Forest Survey Department presents exceptional difficulties, of which the following are the principal: the surface is much broken up, the crop of trees and jungle is dense, the supply of drinking water is precarious and often of bad quality, the forests are infested with wild animals, food is difficult to obtain, and jungle fever is by no means uncommon. The wild animals are not at all appreciated by the unarmed Native Surveyors, and many cases have occurred in which they have caused the most serious inconvenience, stopping the survey of certain tracts for a long time. The experience gained of the Natives of India in the Forest Survey Department has shown that almost anything can be made of them. The principle adopted has been to stimulate them to exertion and to promote a spirit of emulation among them; they were taught that accuracy was of more importance than rapidity, and encouraged to bring to notice all discrepancies in their work. At first only the most simple operations were entrusted to Natives, but a few of them can now do excellent work of the most difficult kind. The combination of European and Native labour has answered very well. Detailed surveys of wild and densely wooded ground have rarely been made before in India, and it is evident that they must be more expensive than similar surveys of open, cultivated country; but to provide them is a necessity and a distinct economy.

THE INDIAN FOREST SCHOOL.

It is only within the last twenty-five years that a special State Department has administered the Indian forests. The staff was at first composed of men who had received no professional education, but they were able to do all that was then needed, and they accomplished work of great value. As a result of their work the State became possessed of large forest areas, from which a permanent supply of produce had to be secured, and which had therefore to be managed systematically. But at this time nothing was known of systematic forestry in England or in India, and an arrangement was made in 1866 under which candidates for the Indian Forest Service were trained on the Continent. The arrangement then made with the French Government is still in force, but it has now been decided to undertake the instruction in England. Great progress has been made in Indian forestry, and this is mainly due to the professionally-trained men with whom the Forest Department has been recruited; but up to 1869 nothing had been done towards the education of the subordinate ranks. As work requiring professional skill became necessary over large areas, it was found that the 'division' must be broken up into a number of smaller executive charges under Natives of the country, and that they must receive a professional education. In 1869 Mr. Brandis made proposals to organise the subordinate grades and to train men at the Civil Engineering Colleges, and several other attempts were made in the same direction, but without marked success.

In 1878 Mr. Brandis proposed to establish a Central Forest School, and his proposals were accepted by Government. The chief object of the school was to prepare Natives of India for the executive charge of forest ranges, and to qualify them for further promotion, but it was hoped that it might ultimately be used to train candidates for the controlling branch. The chief forest officers of provinces were to select candidates and send them to be trained at the school; none but Natives of India* being admitted. A number of forests near Dehra Dún were grouped together as a training ground and placed under a separate Conservator, who was also appointed Director of the school; a board of inspection was also appointed. The first theoretical course was held in 1881, and courses have been held every year since then.

The present system is that the candidates, who must be in robust health, are selected by Conservators of forests or by the Director of the school. They must serve in the forests for at least twelve months before entering the school. Candidates for the Ranger's certificate must have passed the entrance examination of an Indian University on the English side; candidates

* In the widest legal acceptation of the term.—[Ed.]

for the Forester's certificate must have passed a lower examination. The course of training for these two classes extends over eighteen and twelve months respectively. Men who gain the certificates return to their provinces, and are employed there. The course of instruction for the Ranger's class embraces vegetable physiology, the elements of physics and chemistry, mathematics, road-making and building, surveying, sylviculture, working plans, forest utilisation, forest botany, the elements of mineralogy and geology, forest law and the elements of forest etiology. The course for foresters is much more simple. The preparation of manuals is in progress, and a library, museum, chemical laboratory, observatory and forest garden have been established.

The period of probation in the forest before entry into the school has a twofold object: *firstly*, to enable the theoretical course to be understood; *secondly*, to eliminate men who are unsuited to a forest life before time and money have been spent on their training. As a rule, the students are *employés* of the Forest Department, and they draw their salaries and maintain themselves while at the school; no instruction fees being charged. It would not at present be possible to get candidates whose maintenance and education are entirely paid for by their friends. Nine men who have left the school hold appointments worth from £125 to £200 a year, and this ought to draw eligible candidates. Conservators of forests say that the men trained at the school are markedly superior to their untrained comrades. The area of reserved forests has largely increased of late, and the prospects of the students are very good. During the session of 1884 there were forty-six students of all classes at the school, of whom eight were from Madras and seven from Native States, the Chiefs of which have been induced by the establishment of the school to take measures for the protection of their forests. The school has now been made an imperial institution, and this is a great advantage in every way. The expenses of the school in 1884 are said to have been £1,911.

GROWTH OF SAL.

It would be interesting if Divisional officers would give results of their observations on growth of sál for comparison with the figures given below. It is now some years since the system of sample plots with careful yearly measurement of sál trees was instituted, and the data already obtained must be very valuable.

In Kumaon three plots of half an acre each were enclosed in 1881, and measurements have been taken annually for the last four years. These plots were in various parts of the Division, but as they are similar in every respect—except a slight varia-

tion in elevation—the results below given are for the whole area of 1½ acres.

The following is a brief description of the forests experimented on :—

Elevation.—From 1,000 feet to 2,000 feet.

Aspect.—A gentle slope to the south.

Soil.—A well drained sandy loam mixed with boulders and rock.

Standing crop.—125 sál and 16 miscellaneous trees to the acre.

The sál trees are in the following proportion :—

II. Class.		III. Class.		IV. Class and under.
1	:	6	:	14

Undergrowth.—Light grass and a few bamboos.

The results of measurements during four years are as under—

Annual girth increase per tree in inches and tenths.		
II. Class. 4½' to 6'.	III. Class. 3' to 4½'.	IV. Class and under. ½' to 3'.
0·73	0·47	0·28

In 1884, three other plots of two acres each were prepared in close proximity to the half acre plots, the forest being thus precisely similar. These two acre plots were heavily thinned by the extraction of 68 sál and 16 miscellaneous trees per acre, leaving thus 57 sál trees standing on each acre.

The remaining sál trees were in the following proportion :—

II. Class.		III. Class.		IV. Class and under.
1	:	4	:	3

The measurements taken in 1885 of these two acre plots give the following results :—

Annual girth increase per tree in inches and tenths.		
II. Class. 4½' to 6'.	III. Class. 3' to 4½'.	IV. Class and under. ½' to 3'.
0·75	0·76	0·74

We see thus that in the dominant class the annual girth increase remains the same in thinned and natural forest, whilst the suppressed classes have doubled and trebled their annual growth immediately more light and space was afforded. If we take 0·75 inch to be average girth increase of a II. class sál tree in these forests, a period of 24 years would be necessary for a tree of 4½ feet girth to pass into the I. class, but it is probable that in other parts of India, where the sál forests stand in deeper soil and in more favorable circumstances as regards climate, the annual girth increase is considerably larger.

In the Kumaon sál forests the rainfall is about 70 inches, and the range of the thermometer from 30° to 105° Fahrenheit, in the shade.

S. Eardley Wilmot.

LIGHT GRAZING IN THE RESERVES IN THE PLAINS.

I HAVE from time to time read with interest the letters in the *Forester* regarding "light grazing" in the reserved forests; and I would now venture to say that the time has come for Government to take up this important question and form a decision as to whether grazing of cattle (excluding goats and camels) should be prohibited or not in the reserved forests, and there should be some definite rules laid down on this subject; it should not be left to the discretion of Conservators, who may hold widely different views in the different provinces, and thereby Government interests may be prejudiciously affected.

My own opinion, gained after an experience of many years of constant work in the reserved forests, is that, considering all the pros and cons, light grazing is decidedly beneficial than otherwise. It is of course understood that I do not include goats and camels. Some of the best forests I know of are where there is no restriction on grazing (goats excepted), neither is there any protection from fire, but the grass is so kept down that the fires cause little damage, and the reproduction from seeds as well as from shoots is very promising. Whereas *one* fire through the reserved forests does more damage than several decades of light grazing. Perhaps the saddest sight to a Forester is the condition of a reserved forest after a fire has passed through it. I wonder if all those who now hold the posts of Conservators have gone through a forest protected from grazing *immediately* after it is has been burnt; if they have I do not think they would advocate the total exclusion of grazing. The *best* arrangements cannot make sure against fires; on the contrary it speaks of itself for the good conduct of the people in the neighbourhood that such large areas are annually saved from

fire. Of all crimes about the *easiest* to perform and the hardest to detect is that of "forest firing."

My argument for allowing light grazing in all Government forest in the plains, due regard being had to times and seasons, is founded upon the following points :—

(1). Long grass prevents germination and chokes such seedlings as do come up.

(2). The injury caused to germination by light grazing of cows and bullocks is less than that caused by long grass.

(3). The experience already gained in the reserves shows that little natural reproduction takes place in the "open glades," and that the open spaces remain as blank as they were before protection took place.

(4). One fire in a forest protected from grazing causes more injury than a *very* long period of light grazing.

(5). Nature has not produced all this valuable grass to be wasted and destroyed each year without benefitting any one.

(6). Government loses some revenue by this prohibition of grazing.

(7). There is a certain amount of hardship inflicted thereby on the neighbouring people.

(8). A certain amount of expenditure now incurred on "fire protection" will be saved.

Of course where bamboos have seeded or for other special cause it might be necessary to stop all grazing for a few years, but otherwise I think it will be proved conclusively that the present system of entirely excluding cattle from certain reserves not only does no good, but is injurious to the formation of new forests.

A. J. C.

THE MYSORE FORESTS.

Extract from the speech delivered by the Dewan of Mysore, before the Representative Assembly on the 21st October last.

The demand for sandal wood was unusually slack ; and the sales realized only Rs. 3,22,308, or 1½ lakhs less than in 1883-84. This, however, was made good by the larger sale of timber to the public, and by the supply of fuel and sleepers to the railway. The forest revenue on the whole amounted to Rs. 6,57,564. (The expenditure for the upkeep of the establishment is Rs. 2,48,257 ; the net revenue from the forests is therefore Rs. 4,09,307). The important forest regulation is still under discussion ; the subject is surrounded by many difficulties, and this will be readily understood when it is said that in forest matters, even the British legislature, with its great experience, has not yet arrived at a final decision. The Forest Code is under revi-

sion in Bombay, the existing arrangements being deemed very unsatisfactory in the interests of the ryots. In Mysore the subject is at present receiving careful consideration. But I may here mention that the Government of His Highness the Maharajah will enforce as a fundamental principle that local wants, local customs and local systems of tenure should not be disturbed. On the other hand, however, it must be distinctly understood, as population and cultivation increase, it will be necessary for Government to interfere to prevent the wasteful destruction of forests, and to ensure their conservation in the best interests of the people. It will be strongly impressed on the minds of the forest officers that their aim should be to conciliate the villagers in forest tracts, and secure their co-operation by a liberal treatment in respect of their domestic wants.

In connection with forest legislation, I may add that, it is proposed to place the department under an Inspector General of Forests and Plantations. The Government are training three students in the Forest School at Dehra Dún for the post of Assistant Conservators, and it is proposed eventually to give an officer of this class to each district.

THE MAIPHAK.

MR. Hearle has sent us the following from Professor Thiselton Dyer :—

"I have submitted your specimens to my colleague Professor Oliver, the keeper of the Herbarium. He reports :—

"1. The Maiphak of Assam is clearly *Evodia meliæfolia*, Bth. of the Flora Indica. The leaves of a specimen in the Kew Herbarium from Assam (collected by Masters) have the same hairs underneath on the midrib.

"I should imagine there must be plenty of the plant in the Calcutta Herbarium.

"2. The Cordia, collected by Mr. Lowrie in Ajmere, can only be identified as a form of *Cordia Myxa*, which in its present state is a variable species."

KEW :
October 12th, 1885.

THE DESTRUCTION OF PIGS.

MR. F. O. Lemarchand requests us to state that the writer of the article on the destruction of pigs in our last Number has quite unjustifiably used his initials, and that having been the Hony. Secretary of the Lahore and Mian Mir Tent Club for 4½ years, he would be the last person to write such a paper. The use of Mr. Lemarchand's initials was evidently intended as a joke, but we must request correspondents in future not to use our pages for such a purpose.

III. Official Papers.

MEMORANDUM ON THE COLONIAL AND INDIAN EXHIBITION TO BE OPENED IN LONDON IN MAY 1886.

A Note on the space available in the Imperial Court for the Forest and Mineral Collections with suggestions as to subjects which would seem to deserve special attention.

Deducting the space occupied by paths, the floor space allowed for the Imperial Court amounts to only 4,240 square feet, with a wall space of 5,910 square feet.

His Royal Highness the Prince of Wales, in a letter enclosed in a Despatch from the Secretary of State for India, dated 12th February, 1885, states :—" Much interest is taken in this country in the woods of the various Colonies and Dependencies of the Crown, and I shall be glad if a good representation of those of India is made."

To carry out fully the wishes of His Royal Highness more space would be required than can be devoted to timbers, but it is understood that a fairly good collection will be shown and can be accommodated within the space available.

It is, however, impossible to give to the Forest Department the 3,500 square feet of floor space asked for by the Inspector General. After careful consideration, it has been found that only 400 square feet of floor space can be assigned to the Forest Department. This is shown in the accompanying Ground Plan* as Sub-Courts No. II. and III. These numbers should be given in Roman character, on the outside of each case containing timbers.

It is believed that the space asked for by the Inspector General of Forests was intended for the exhibition of all the collections made by the Department, *e.g.*, including Gums, Dyes, Tans, Fibres, Medicines, and Food-stuffs as well as Timbers. It has now, however, been finally agreed upon that collections of Minor Forest Products will be grouped with the corresponding exhibits obtained from all other sources. Thus, for example, the fibres collected by the Forest Department will appear in (XXII.); gums in (XXXIII.), and so on. While the Forest Department collections will be thus broken up according to a distinct system of classification, the names of the collecting officers will be clearly shown on each specimen.

The separate space allotted to the Forest Department in the

* Not reproduced.

Imperial Court will thus be occupied entirely by the collections of timbers, and it is therefore hoped that a floor space of 400 or 500 square feet, with a wall space of 1,000 square feet, will be found sufficient. This wall space will be available on the walls around the Sub-Courts numbered II. and III., but a further space of one foot in depth, running along the whole of both walls of the Imperial Court, will be devoted to timbers if found necessary.

Should the areas marked II. and III. with the wall space indicated be found insufficient, this might be increased by the erection of a triumphal gateway built up of blocks of wood, similar to that constructed at the entrance to the Forest Department Court of the late Calcutta International Exhibition. A gateway, if constructed, should face the transverse path A, and it might consist of one large arch and two smaller ones. It might be 25 feet in breadth, 10 to 15 feet in height, and 5 feet in thickness, and since it would stand isolated, it could be inspected on all four sides, thus affording much additional wall space for the display of blocks of timber.

An admirable suggestion has been made by Mr. Ribbentrop, Officiating Inspector-General of Forests, that a special trophy should be devoted to "Bamboo and its uses." This is provisionally shown in the Ground Plan in the form of a bridge, thrown over the middle of the transverse path B, between the Assam and Bengal Ethnology Sub-Courts. If constructed this trophy would thus be situated in the centre of the Imperial Court and between the two chief trophies, namely, cereals and fibres. Visitors walking along the longitudinal path F would have to pass over this bridge, and while studying the multitude of objects made of bamboo and the numerous forms of bamboo itself, which would be worked into designs on the bridge, they would at the same time command a complete view of the Court. By placing this bridge, so that it could be entered by the small central path only, crowding would be prevented. It might be built on four pillars each 2 feet square, placed in front of the corners of the four Ethnology Sub-Courts, and encroaching one foot on either side on the transverse path B, and one foot on the Ethnology Sub-Courts. The bridge would require to be square, the passage below being 7½ feet in height and the platform 8½ feet above the ground. It would, of course, in the first instance, require to be constructed of a strong wooden or iron framework, but like a rustic bridge, it might be completely covered over with bamboos. The approaches would be on the path F, and should be made by a series of steps, 9 inches in height and 1½ feet in breadth. A railing 2½ feet in height might be made entirely of bamboo passing up both sides of the stairs and over the bridge. The approaches would have to be open below, but they could be lined above and below with bamboo, and underneath the bridge, on the path F, might be placed

two rustic bamboo chairs, each 5 feet in length. These chairs could be hung all round with objects made of bamboo, such as fishing baskets, traps, knives, spoons, musical instruments, &c. These chairs would also command a view of the Assam and Bengal Ethnology Sub-Courts. The four pillars already described might rise to a height not exceeding 15 feet above the ground, and as they would occur on the four corners of the bridge they would be ornamental, and could be completely covered with bamboos. In recesses, constructed on the top portions of these pillars, might be shown glass-jars containing edible portions of bamboo, such as bamboo-grain and bamboo-shoots, the latter boiled like asparagus or preserved as *Chow-chow; Tabashir*, or the crystalline substance obtained from the interior of the bamboo culms might also be shown here. Bamboo-paper-fibre and bamboo-paper might find a prominent place. The approaches to the bridge could not of course be more than 5 feet in breadth, but the top of the bridge, by projecting one foot on either side beyond the pillars, would become 10 feet in length and breadth. Gates also constructed of bamboo might be placed at each approach, and to regulate the number of people allowed on the bridge should any difficulty arise from over-crowding, these gates could be locked and the structure by itself would still be attractive.

Of the Minor Forest Products, special attention might be directed to the following :—

1st.—FIBRES. These may be referred to two sections, *viz.* :—

(*a*). Fibres suitable for the textile industries, *e. g.*, for ropes and fabrics. The subject of silk substitutes is attracting attention at the present moment. Jute, which is a most perfect substitute for silk, has the disadvantage of being readily destroyed by moisture. A good and cheap fibre more durable under the influence of water than jute would command an immediate market. Rhea and other nettle fibres are also of great interest, but it would seem that a mistake has been hitherto made in concentrating all enquiries on rhea proper. The *ban-rhea* of Assam and many other allied nettle and rhea fibres deserve careful investigation, and it is hoped that large collections of all the Urticaceous fibres may be shown. The fibres from the *Malvaceæ, Sterculiaceæ*, and *Tiliaceæ*, also deserve careful investigation, and the Monocotyledonous fibres, *e.g.*, the aloe and pine-apple fibres, are daily growing more and more important. It is indispensably necessary that a small dried flowering and leafy specimen of the plant from which each fibre is prepared should be furnished whenever this is possible.

(*b*). Fibres suitable for paper-making. These require scarcely any preliminary preparation, and it is this charac-

teristic that has rendered Esparto and other grasses favourite paper fibres. They are placed in the vats and reduced to pulp direct. It would never pay to devote to paper-making even a fibre which may be separated as cheaply as jute, unless that fibre chanced to be quite useless for the textile industries, and thus fetched an exceedingly low price in the market. The paper-maker cannot compete with the spinner in the purchase of fibres. It is believed, however, that the subject of grasses and herbaceous plants suitable for paper-making has not as yet been thoroughly investigated. Questions of export must be borne in mind, unless the proposed fibre can be cheaply cultivated on accessible tracts of land; but in cultivation paper fibres cannot compete with ordinary agricultural produce, so that the most likely fibre would be a wild one answering the requirements indicated above, namely, cheapness and quantity.

2nd.—Gums, Resins, Extracts, and Gutta-percha and Caoutchouc.

It is remarkable that the bulk of the resin consumed in India has to be imported, and it is believed the gum trade might be greatly extended. At the present moment the so-called East Indian Gum which reaches Europe from Bombay is almost entirely imported from the Persian Gulf and re-exported from Bombay. The trade in catechu requires careful investigation, and collections from all the forests of India showing chips of the wood before and after boiling, the extract in all its stages, the forms in which it enters the market, samples of the implements used in its preparation, statistical information as to the amount annually produced and market for which it is prepared, would be very valuable. Gum kino and gambier require to be similarly investigated and collections supplied. The subject of India rubber, or milky saps, which on hardening resemble either gutta-percha or caoutchouc, should be carefully looked into, and detailed information and specimens furnished.

As with fibres so to a greater degree with gums and the other articles alluded to in this paragraph, it is necessary to accompany the exhibits with dried samples of the plants from which they have been collected. A twig of the plant brought in by the Forest Ranger might be simply hung out to dry* in the sun, and then placed in the mouth of the bag or basket containing the corresponding economic product.

3rd.—The subject of Forest Dyes and Tans would richly reward careful investigation, and where possible the dye product

* For directions to dry such specimens, see a separate note, No. 5 of this series—"Hints as to making and despatching collections of Raw Products and Rough Manufactures."

exhibited should in each case be accompanied by samples of the mordants or dye auxiliaries used. A sample of dyed cloth and a note describing the process of dyeing would make the collections complete. Similar information would be most valuable in the case of tans.

Under the term "Extra Forest Products" might be included all wild fruits, leaves, roots or other structures eaten regularly or in time of famine only, by the poorer people; also all fodder grasses, bushes or trees. Fruits that cannot be sun-dried might be preserved in small bottles with spirits of wine or ordinary country spirit. All such collections must, however, be put in a separate box by themselves, for should the bottles get broken, oils, spirit, honey or other liquid samples would destroy completely fibres or other exhibits. Liquids should, therefore, be packed by themselves, the bottles being each wrapped up in waste jute or other fibre, and packed together in a small box. Specimens of food and fodder plants should be dried as directed; but small sheaves, sun-dried, would be most acceptable. Bees, hives, wax, honey, and ants, would also come under the head of Extra Forest Products, and as these are receiving much attention at present, collections would be highly prized.

If the honey is extracted, only combs quite free from young bees should be used for this purpose. The honey should be allowed to drain naturally from the combs. In addition carefully selected combs with honey in them should be placed in jars and sent in this form. Honey expressed from mixed combs containing insects, ferments rapidly and becomes useless. Indigenous hives, as used by hill tribes or wild hives, would be most interesting, and, as far as possible, a few bees corresponding to the combs or hives, should be preserved in spirit and numbered so as to allow of identification with the hives. The resin-yielding bees of Burma and Assam should be carefully collected and perfect hives should be screwed into separate wooden boxes so that they may arrive without being injured.

It is intended to make an effort to show the Indian ants. Some of these are regularly eaten by hill tribes, and ants'-nests would be most interesting; but, as with hives, samples of the corresponding insects should be carefully preserved. It is proposed to try and take one or two complete ant-hillocks, as these form in some forests a characteristic feature. One or two, 6 or 8 feet in height, carefully cut out and packed in separate boxes, would form an attractive show in the Forest Court.

The attention of Forest Officers might be specially drawn to the subject of Silk. Of all the Extra Forest Products this is by far the most interesting. The demand has arisen for a wild insect that may take the place to some extent of the mulberry silk insect, and there is no knowing which of the numerous obscure wild silks may be found the one most serviceable. All silk collections should as far as possible consist of specimens of

the plant or plants on which the worms feed ; caterpillars or silkworms preserved in spirit in all stages of growth ; eggs ; cocoons both perforated and with live or with dead insects ; specimens of the male and female perfect insects—these may be placed separately in small boxes tied together, three or four in a set, with one box filled with camphor—thread reeled or spun from the cocoons and cloth manufactured from them. Specimens of the crude appliances used by the hill people in their silk manufactures would also be highly instructive. Where an officer is prepared to give the subject of silk his special attention, the Revenue and Agricultural Department would be glad to place at his disposal special funds for this purpose. In all such cases application must first be made to the Exhibition Branch, stating what collections it is proposed to make and the amount of money necessary.

From the preceding remarks regarding silk, it might perhaps be inferred that only the silkworms known to the natives were required. The wild ones not at present used in any way would be quite as interesting, however, as those known to yield a useful fibre.

The Minerals occupy the Sub-Court marked XLI. Blocks of Stones and Building materials might also be arranged on the floor and against the wall, along the longitudinal paths E and G. In the despatch to which reference has already been made in the opening paragraph of these suggestions, His Royal Highness the Prince of Wales says :—" It is very desirable that the higher class Building Stones should be fully exhibited." Arrangements will be made to show to advantage the mineral collections which may be received ; special attention is desired to the subject of marble.

GEORGE WATT,

On Special Duty with the Government of India, Department of Revenue and Agriculture.

ENSILAGE.

As the experiments in ensilage conducted during 1884-85 at Allahabad in connection with the preservation of grass, were perhaps larger and more comprehensive than any experiments which ever took place at any other one place, I propose submitting a report showing generally the process of this method of the underground preservation of grass, and in detail the contents and outturn of the several silos dug in Allahabad Cantonments.

Eighty-four silos in all were dug, and filled with grass, &c., between 23rd July and 29th October, 1884. The dimensions of the majority of these were 30′ × 12′ × 6′, while the rest were of various sizes.

The silos were so situated, as to be in the centre of the plot,

from which it was intended the grass should be cut. This was done to avoid the necessity of engaging carriage to take the grass to the pits, and by these means the only expense incurred in filling the silos was the contract rate of cutting the grass, *viz.*, about 9 pie per maund.

It was found by experiment that a field or plot of about five acres of ordinary grass land, will fill a silo 30′ × 12′ × 6′ dug in the centre of it. The coolies who cut the grass will carry it and throw it into the pit.

The cost of three silos of the above size was Rs. 11, or at the rate of Rs. 1-11-2 per 1,000 cubic feet. In addition to Rs. 3-10-8 for excavating the silo, there is the charge for covering and uncovering it with 4½ feet of earth, which is about Rs. 1-5-4, and hence the total expense connected with a silo 30′ × 12′ × 6′ containing 600 maunds of grass should be about Rs. 5.

The principle on which these experiments were carried out, was to find out the very cheapest method of preserving grass, karbi, mothi, &c., so as to bring it within the power of the poorest villager to store food for his cattle. It was with this object that only earth silos were dug, no elaborate means of draining or pressing were attempted, the experiments were conducted in the simplest and cheapest form, and though a small percentage of the silos was not good, yet on the whole the experiment may be deemed to have been highly successful, and considering that the operations were nothing more than digging a hole in the ground, and filling it with grass, it is highly satisfactory that over 40,000 maunds of food so stored, should have been eaten, and eaten with relish by the cattle (numbering 1,000) and upwards of 1,200 ponies.

To examine the financial results of the above operations it will be seen that roughly speaking the silos containing these 40,000 maunds of fodder cost Rs. 350, and the cost of cutting the grass was Rs. 1,875, and thus giving even the liberal allowance of 40 lbs. per head per bullock per day, it would be possible to feed 80,000 cattle for Rs. 2,225, or in other words, to forage over 200 bullocks daily for a whole year at a total cost of Rs. 2,225, or at the rate of Rs. 11 per bullock per annum.

Now, at the most moderate computation, and giving only 20 lbs. per diem, it would cost to feed a bullock on bhúsa Rs. 45 per annum, or more than four times as much as the ensilage. This is taking the rate of bhúsa at 8 annas per maund.

The only precautions necessary in filling an earth silo, are to heap the grass as high above the surface of the silo, as the depth of the silo, and then to cover the grass so heaped up with the whole of the earth which has been previously excavated, care being taken to cover a margin of 2 feet all around the sides of the pit, to keep out air and water. With a few exceptions nearly all the Allahabad silos were filled while it was raining hard.

When a silo has been covered up great care must be taken in filling up any cracks or crevices the moment they happen to appear.

For the first twenty-five silos that were made an elephant was employed to press the grass, but subsequently the services of the elephant were dispensed with, and no pressure other than the weight of the excavated earth was used. The latter appears to be quite sufficient, and is the least expensive form of pressure that can be applied. It is of course highly important that the weight of the earth so put on should be equally distributed.

Another form of pressure that was tried was wooden sleepers; but unless great care is taken in placing the grass evenly, it is very difficult to obtain an equal pressure, as the sleepers being flat will naturally press only on the highest points of the grass. Our experience seems to show, that the earth pressure is all that is necessary, if carefully applied.

A most important result was obtained from 12 silos, which were made along the line of rail between Allahabad and Manauri, for though they were filled almost entirely with the coarsest description of grass, *viz.*, kúsa, kásá, and gánhra grasses, which make poor hay, yet the ensilage turned out excellent.

The coarse grasses came out of the silo soft and succulent, and that they were nutritious and palatable was proved by the condition of the bullocks during the issue of this ensilage, and by the greedy manner in which the animals devoured this fodder.

I think also that results proved that for the purpose of being siloed, grass should be cut either with the "jabao" (small circular scythe) or with the "hassa" (sickle), and not with the "kurpa," for with the latter it is almost impossible to avoid scraping up dirt and roots, which not only make the ensilage gritty and unpalatable, but also tend to cause it to have an obnoxious smell.

After opening the silos on the railway, we opened eleven that had been dug on the Fort Esplanade. These were formed from the following good grasses, *viz.*, bandari, janewah, mussél and dhúb, and turned out excellent. These grasses had been in the pits about six months, and came out as grèen as when put in.

I then had to open out the silos in New Cantonments. These did not turn out so well as those on the railway and fort, and three or four were so bad that they had to be closed again. The smell of this ensilage while in the pit was malty, but when removed and exposed to the air, it became unpleasant, resembling a tan-yard in smell. Most of it, however, was greedily devoured by the cattle, though some three or four silos could not be used.

The reason the silos in New Cantonments were not so good as the others can fairly be attributed to the fact that the grass put into them was immature and young, and from this the following deduction can be made :—Ensilage to be good should be

made from grass cut just before it flowers, and this will allow a good second crop to spring up for hay.

The Transport Lines in Allahabad are in every way inconveniently situated, being in what are called the Chatham Lines, three or four miles away from the barracks, Commissariat godown, and other places in which the bullocks are called upon to work. This necessitates most of the bullocks for duty having to walk four miles before their work is begun, and again to perform a return journey of four miles when their work is finished.

Carrying the ensilage to the Chatham Lines was fraught with a great deal of inconvenience, for to get there from New Cantonments necessitates passing through the greater part of the Civil Station, the inhabitants of which naturally complained of the smell of the ensilage. As soon as it was found that annoyance was being caused, the issue of ensilage to the animals in the Chatham Lines was stopped.

Ensilage has a curious smell, very like that of a tan-yard, which is unpleasant to any one unaccustomed to it, but which ceases to be unpleasant after one is used to it. There is nothing to show that the smell is at all unhealthy, on the contrary the coolies who were employed daily on the silos, kept in excellent health, and the siege train bullocks who were fed almost entirely on it, kept well and in very good condition. There was only one death amongst these animals, and that was caused by rinderpest. This epizootic disease spread considerably amongst the new bullocks bought for the proposed expedition to Quetta, and caused many deaths. The Commissariat slaughter cattle were fed almost entirely on ensilage, and nothing else, with the most favourable results. I mention this as an idea seemed to have gained ground, that the deaths amongst the new purchases were due in some way to the ensilage. This can hardly be maintained in the face of the following facts :—

(*a*). Siege train bullocks fed on ensilage from the time of the first silo being opened to the last being closed, kept well and in good condition.

(*b*). Slaughter cattle same result.

(*c*). Slaughter sheep fed partially on ensilage with good results.

(*d*). Ponies fed on ensilage.

I think it has since been incontestably proved, that the death among the new bullocks were due to rinderpest, and that this disease was raging in the villages round about Allahabad is well-known, and was witnessed by the Major-General and Deputy Assistant Quartermaster-General of the Division, who when out in the district, saw the corpses of many hundreds of bullocks that had been carried off by this disease.

I made an experimental silo with wonderfully good results. It was filled in the following manner:—At the bottom was placed about 2 feet of green "mothi," next some rather dry

múnj, on this came some 2 feet of chaffed sorghum, then a layer of dry karbi, pressed down by about 6 inches of green mothi, and on the top of all a layer of sorghum. This pit was opened on 13th May, 1885, after having been covered for 6½ months. Two inches sorghum at the top had to be discarded. The remaining articles came out most excellent, the dry karbi, appearing as juicy and fresh as the green. The animals devoured this ensilage in the greediest manner.

I attach a statement showing the result of each silo in detail, and in conclusion I submit the following summary of what would appear to be the facts ascertained in connection with this most interesting experiment, which was conducted on so large a scale at Allahabad this year :—

(1). It does not appear necessary to go to the expense of building masonry silos, or to take any particular precautions in draining and pressing, as an earth silo seems to fulfil all the necessary conditions, and apparently drains itself if kept air and watertight.

(2). The only pressure that seems to be necessary, is that caused by the excavated earth being piled on the grass.

(3). The best time to cut the grass is when it is mature, between 15th August and 1st November, this will give a second crop for hay.

(4). The fact of its raining while a silo is being filled, does not appear to do any harm.

(5). The ensilage should be issued green, *i.e.*, as it is taken out of the pit.

(6). Thirty-five lbs. of ensilage would appear to be equal to 20 lbs. of bhúsa, the ration of a siege train bullock.

(7). Ensilaged karbi forms good food for elephants.

(8). The fact of cutting the grass for ensilage, gives a finer and better second crop for hay-making.

(9). Silos should, in my opinion, be made wedge-shaped, *i.e.*, rather wider at the top than the bottom, and with sloping sides, to preserve an even pressure. The floor and sides might be baked by burning rubbish in the pit.

I trust that the experiments at Allahabad may in the course of time show the villagers and country people, that they have now a sure and safe means at hand for preserving fodder for their cattle, and a cheaper method by far of procuring good fodder than any now in existence ; and in conclusion I would point out that the success of these experiments is mainly due to the intelligence and hard work of Sergeant Meagher, of the Commissariat Department, who has not only been out in all weathers, but has taken an intelligent interest in the operations, which has gone far to make them so successful.

S. C. F. PEILE, *Captain*,
Asst. Commissary-General.

Silos dug in New Cantonment.

Date when covered.	Time taken in filling.	Dimensions.	Weather when filling.	Contents.	Kind of pressure.	Date when opened.	Remarks.
23rd July, 1884, ..	Hours. 3	Top 10' 8" × 5' 9", .. Bottom base 9' 6" × 4' 3", Depth 4' 3", ..	Raining hard,	116 maunds of immature grass,	3 feet of earth,	November 1884,	Ensilage brownish, smell unpleasant, issued after being dried.
29th July, 1884, ..	Days. 4	Top 30' × 12', .. Bottom 28' 6" × 12', Depth 6', ..	Do., ..	750 ditto,	Elephant pressure and 5 feet of earth,	11th Nov., 1884,..	Ensilage green and very wet A little at top and sides was bad, remainder issued green.
8th Aug., 1884, ..	2	30' × 12' × 6', ..	Fair, ..	650 ditto,	Ditto,	21st April, 1885,	Ensilage green and wet, smell unpleasant, but issued and eaten in one day. Top and sides not issued, being bad.
10th Aug., 1884, ..	3	28' × 12' × 6', ..	Very rainy,	525 ditto,	Ditto,	22nd April, 1885,	Ditto ditto ditto.
12th Aug., 1884, ..	4	Top 28' × 10', .. Bottom 27' × 8', .. Depth 6', ..	Raining,	415 ditto,	Ditto and 4 feet of earth,	23rd April, 1885,	Ensilage good, green, and wet, scarcely any heat in silo.
8th Aug., 1884, ..	3	30' × 12' × 6', ..	Raining night and day,	800 ditto,	Ditto and 5 feet of earth,	Not yet opened. ..	..

10th Aug., 1884, ..	2	30' × 12' × 6',	..	Raining,	850 ditto,	Ditto, ..	Ditto,	..	..
12th Aug., 1884, ..	2	{Top 30' × 12' Bottom 28' 6" × 10' 6"} × 6',	..	Very rainy,	750 ditto,	Ditto, and sleepers laid across,	April 1885,	..	Ensilage on top for 3 feet bad, wet, and jammed up into cakes; color black, smell offensive, heat 105°, not issued.
12th Aug., 1884, ..	2	{30' × 12' / 29' × 11'} × 6',	..	Raining,	750 ditto,	Ditto, no sleepers,	1st February,	..	Green, wet, and good, no heat in silo.
12th Aug., 1884, ..	2	{Top 29' 6" × 12' Bottom 28' × 10'} × 5' 6",	..	Very rainy,	650 maunds of rather ripe grass,	Elephant and 5 feet of earth,	May 1885,	..	Ensilage excellent, issued in one day, color green, heat 90°.
13th Aug., 1884, ..	2	{Top 30' × 12' Bottom 27' × 8'} × 6',	..	Fair, ..	670 maunds of immature grass,	Ditto, ..	Not opened.	..	..
14th Aug., 1884, ..	3	24' × 10' × 6',	..	Raining,	650 ditto,	Ditto, ..	..		Ensilage excellent, issued in one day.
18th Aug., 1884, ..	4	30' × 12' × 6',	..	Very rainy,	640 ditto,	Ditto, ..	April 1885,	..	Left open 2 days after being filled. Little on top of sides bad, otherwise good.
19th Aug., 1884, ..	2	32' × 12' × 6',	..	Fair, ..	650 ditto,	Ditto, ..	May 1885,	..	Very good, no heat.
20th Aug., 1884, ..	3	30 × 12' × 5' 9",	..	Do, ..	700 ditto,	Ditto, ..	Ditto,	..	Very good, 105° Fahr.
21st Aug., 1884, ..	4	{30' × 12' / 29' × 12'} × 5' 8",	..	Do., ..	800 ditto,	Ditto, ..	April 1885,	..	Color black, ensilage bad and jammed into cakes. Water must have got into this silo.
21st Aug., 1884, ..	3	{30' × 12' / 26' × 8'} × 6',	..	Do., ..	400 ditto,	Ditto, ..	May 1885,	..	Good, 105° Fahr.
28th Aug., 1884, ..	3	{30' × 12' / 29' × 11'} × 6',	..	Do., ..	700 ditto,	Ditto, ..	April 1885,	..	Ensilage good, smell pleasant and sweet, scarcely any heat.

Soils dug in New Cantonment—(continued).

Date when covered.	Time taken in filling.	Dimensions.	Weather when filling.	Contents.	Kind of pressure.	Date when opened.	Remarks.
	Days.						
28th Aug., 1884, ..	2	$\left\{\begin{matrix}32' \times 12' \\ 30' \times 8'\end{matrix}\right\} \times 5'$, ..	Fair,	752 maunds of immature grass,	5 feet of earth only,	April 1885, ..	Green and wet, fair ensilage 90° Fahr.
30th Aug., 1884, ..	3	40' × 16' × 6', ..	Do.,	1,400 ditto,	7 feet of ditto, ..	March 1885, ..	Filled with long coarse grasses. Ensilage excellent, smell sweet, 110° Fahr.
30th Aug., 1884, ..	2	30' × 11' × 6', ..	Do.,	720 ditto,	5 feet of do.	Ditto, ..	Ditto ditto.
3rd Sep., 1884, ..	5	30' × 12' × 6', ..	Very rainy,	652 ditto,	Elephant and ditto,	April 1885, ..	Smell unpleasant, heat 85° Fahr. Ensilage fair.
3rd Sep., 1884, .	4	30' × 12' × 6', ..	Do.,	732 ditto,	Ditto, ..	Ditto, ..	Ditto ditto.
31st Aug., 1884, ..	2	30' × 12' × 6', ..	Rainy,	700 ditto,	5 feet of earth only,	Ditto, ..	Ditto ditto.
2nd Sep., 1884, ..	3	30' × 12' × 6', ..	Do.,	800 maunds of nearly ripe grass,	Ditto, ..	May 1885, ..	Ensilage excellent, smell vinous, 95° Fahr.
3rd Sep., 1884, ..	2	30' × 12' × 6', ..	Do.,	820 ditto,	Ditto, ..	21st April, 1885,	Ensilage excellent, smell vinous, temperature cool.
5th Sep., 1884, ..	1½	30' × 12' × 6', ..	Fair, ..	761 ditto,	Ditto, ..	April 1885, ..	Ditto ditto.
5th Sep., 1884, ..	2	30' × 13' × 6', ..	Do.,	765 ditto,	Elephant and ditto,	Ditto, ..	Ensilage inferior, color black and jammed into cakes. Water must have got in or possibly too much pressure.

6th Sep., 1884, ..	1½	18' × 18' × 9', ..	Fair, ..	1,100 maunds of almost ripe grass,	Earth on top, ..	3rd April, 1885, ..	Ensilage excellent, pit cylindrical in shape, color green. No heat. The best silo opened.
8th Sep., 1884, ..	3	30' × 12' × 6', ..	Do., ..	707 ditto, ..	5 ft. of do.,	April 1885, ..	Ensilage good, green, and wet. Temp. 90°.
8th Sep., 1884, ..	3	30' × 12' × 6, ..	Do., ..	800 ditto, ..	Ditto, ..	Ditto, ..	Ditto ditto.
9th Sep., 1884, ..	2	30' × 12 × 6', ..	Do., ..	750 ditto, ..	Ditto, ..	Ditto, ..	Ditto ditto.
9th Sep., 1884, ..	2	30' × 12' × 6', ..	Do., ..	800 ditto, ..	Ditto, ..	Ditto, ..	Ditto ditto.
21st Sep., 1884, ..	7	30 × 12' × 6', ..	Rainy, ..	693 ditto, ..	Ditto, ..	May 1885, ..	Good, color brown, smell sweet, 108° Fahr.
20th Sep., 1884, ..	3	30' × 12 × 6', ..	Fair, ..	527 ditto, ..	Ditto, ..	Ditto, ..	Very good, quite different smell, 105° Fahr.
28th Sep., 1884, ..	4	30' × 12' × 6', ..	Rainy, ..	688 ditto, ..	Ditto, ..	27th March, 1885,	Made of coarse grasses, smell very vinous. Heat about 110° Fahr.
4th Oct., 1884, ..	2	30' × 12' × 6', ..	Fair, ..	733 ditto, ..	Ditto, ..	30th March, 1885,	Same as above, ensilage drier.
8th Oct., 1884, ..	2	30' × 12' × 6', ..	Do., ..	476 ditto, ..	Ditto, ..	April 1885, ..	Ditto ditto.
4th Oct., 1884, ..	2	30' × 12' × 6', ..	Do., ..	611 ditto, ..	Ditto, ..	29th March, 1885,	Ditto ditto.
6th Oct., 1884, ..	3	30' × 12' × 6', ..	Do., ..	688 ditto, ..	Ditto, ..	March 1885, ..	Ditto ditto.
4th Oct., 1884, ..	5	30' × 12' × 6', ..	Rainy, ..	700 ditto, ..	Ditto, ..	April 1885, ..	Color brown, ensilage dry and good, smell sweet, heat 110° Fahr.
9th Oct., 1884, ..	3	30' × 12' × 6', ..	Fair, ..	750 ditto, ..	Ditto, ..	Ditto, ..	Ditto, heat 130° Fahr.
12th Oct., 1884, ..	3	30' × 12' × 6', ..	Do., ..	800 ditto, ..	Ditto, ..	Ditto, ..	Ditto ditto.
13th Oct., 1884, ..	3	30' × 12' × 6', ..	Do., ..	Kurbi, ..	Ditto, ..	Ditto, ..	Kurbi, ensilage was excellent, almost the same color as when put in.
24th Sep., 1884, ..	5	30' × 12' × 6', ..	Do., ..	Bajra, mothi múnj, ..	Ditto, ..	Not yet opened ..	
29th Oct., 1884, ..	4	30' × 12' × 6', ..	Fine, ..	Sorghum mothi, kurbi,	Ditto, ..	May 1885, ..	Ensilage excellent, heat 100° Fahr. The best ensilage made, devoured greedily by animals.

Silos dug in the Chatham Lines.

Date when covered.	Time taken in filling.	Dimensions.	Weather when filling.	Contents.	Kind of pressure.	Date when opened.	Remarks.
	Days.						
16th Sep., 1884, ..	3	30′ × 12′ × 6′, ..	Rainy,	650 mds. immature grass,	Elephant & 5 ft. earth,	April 1885, ..	Ensilage good, all alike, color green, smell vinous, heat 90° Fahr.
21st Sep., 1884, ..	4			700 ripe, ..	5 feet of earth only, ..		
17th Sep., 1884, ..	3			756 do., ..			
22nd Sep., 1884, ..	6			550 do., ..			
20th Sep., 1884, ..	3		Fair, ..	750 do., ..			
24th Sep., 1884, ..	2		Rainy, ..	706 do., ..			

Silos dug on the Fort Esplanade.

Date when covered.	Time taken in filling.	Dimensions.	Weather when filling.	Contents.	Kind of pressure.	Date when opened.	Remarks.
11th Sep., 1884, ..	2	30′ × 12′ × 6′, ..	Fair,	737 mds. mature grass,	5 feet of earth only.	In March and April 1885.	Ensilage excellent throughout, green in color. Small sweet, heat alike throughout, about 90° Fahr.
13th Sep., 1884, ..	2			750 ditto, ..			
12th Sep., 1884, ..	2			745 ditto, ..			
12th Sep., 1884, ..	3			768 ditto, ..			
13th Sep., 1884, ..	1		Rainy,	650 ditto, ..			
21st Sep., 1884, ..	1			716 ditto, ..			
23rd Sep., 1884, ..	2			649 ditto, ..			
22nd Sep., 1884, ..	1			504 ditto, ..			
24th Sep., 1884, ..	2		Fair,	440 ditto, ..			
17th Sep., 1884, ..	2			618 ditto, ..			
20th Sep., 1884, ..	3			484 ditto, ..			

Silos along the Line of Railway.

3rd Sep., 1884, ..	4	30' × 12' × 6', ..	Rainy,	600 mds. mature grass,	5 feet of earth only.	In Feb. and March 1885.	The whole of the ensilage though composed of coarse grasses, was excellent. Light green in color, sweet in smell, and greedily devoured by the cattle. Heat 90° Fahr.
6th Sep., 1884, ..	4			650 ditto, ..			
8th Sep., 1884, ..	4		Fair,	790 ditto, ..			
12th Sep., 1884, ..	4			600 ditto, ..			
12th Sep., 1884, ..	3			550 ditto, ..			
16th Sep., 1884, ..	2			557 ditto, ..			
18th Sep., 1884, ..	2			535 ditto, ..			
21st Sep., 1884, ..	2			591 ditto, ..			
23rd Sep., 1884, ..	2			550 ditto, ..			
25th Sep., 1884, ..	2			565 ditto, ..			
30th Sep., 1884, ..	6	40' × 15' × 6', ..		900 ditto, ..			

About 10 silos still remain unopened, as an experiment to see what they will be like next year. Not included in this statement.

IV. Notes, Queries and Extracts.

FOREST CONSERVANCY AT HOME AND ABROAD.

The report of the Select Committee "appointed by Parliament to consider whether by the establishment of a forest school, or otherwise, our woodlands could be rendered more remunerative," has just been issued, bearing the date of July 24th, and they express the opinion that so near the end of the Session it would not be in their power to conclude their investigation. They could only report to the House the evidence already taken, and recommend that another committee on the same subject should be appointed in the next Session of Parliament. It will be inferred from this that no decision was arrived at, and the vexed question of establishing a school of forestry for educating young men exclusively for the pursuit of that science, remains practically in the same state as before.

But although the sittings of the committee were inconclusive, the mass of evidence collected from experienced authorities and from various lands, leaves little doubt on the mind of the reader of the report that the investigation will terminate in any other way than by approving the inauguration of an endowed institution, where forestry can be taught and some sort of degrees or distinctions conferred, as in the schools and colleges for other objects. The committee, under the presidency of Sir John Lubbock, was only nominated on the 8th of July, and it held its last sitting (of three) on the 24th. At the first assemblage only one witness was examined. Mr. W. G. Pedder, head of the Revenue Department of the India Office, through whose hands all the forest papers from India pass, and who has had a good deal to do with forests as Secretary to the Bombay Government.

No attention was paid, it seems, to the forests of India until 1846, when a department was organised in the Bombay Presidency, under the late Dr. Gibson, "principally with a view of providing and securing supplies of teak timber for the dockyards." In 1847 the Madras Presidency followed suit, and the organization extended to Bengal and Burmah, and from that date the systematic conservancy of the forests of India may be said to have begun.

Mr. Pedder found some difficulty in stating what the revenue derived from forests was before that time, but he understood it

to be about £50,000. At all events in a year or two it arose to £150,000, and in 1859 to £182,000; the charges were £32,000, and the net revenue £150,000. In 1883-84 the gross revenue was £938,000, the charges £567,000, leaving net revenue £371,000. The training of Indian forest officials scientifically began about 1863, since which not only has the revenue thence derived greatly increased, but the capital value of the forests has increased still more, chiefly, it is intimated, as a consequence of these appointments. These officials, it appears, were sent to Europe for their training—chiefly to France and Germany, not to England, which was not supposed to be capable of affording them sufficient opportunities of scientific forest learning, and for the last ten years the Indian forest officers have been trained at the Ecole Forestière at Nancy. The fees, it seems—which cover board, lodging, and the requisite lectures, everything in fact but pocket-money—amount to £180 per annum; and two years' attendance are thought necessary to make an efficient forester, but only for the higher grades of the service, such as those of "Conservator, Deputy Conservator, and Assistant Conservator. There is a special school in India for the instruction of the inferior grades." Now it is arranged that "young officers—from five to seven or eight a year—are to be selected, subject to a physical test, by a competitive examination held by the Civil Service Commissioners. The young officers selected are to be sent for two years to go through a course at the Royal Indian Engineering College at Cooper's Hill, and there will receive instruction in mathematics, applied mathematics, geometrical drawing, freehand drawing, surveying, descriptive engineering, inorganic chemistry, geology, French, physics (laboratory work)," and a good deal besides, including forest subjects, botany, &c., to be studied in Windsor Forest and other places, and a holiday tour in France each year in connection with the school at Nancy. As yet it seems there have been no applications for these honours, but Mr. Pedder remarks that "any young men whose parents will pay the fees will be able to avail themselves of the instruction given in forestry." It is also stated that since 1867, when the system began, to 1885 there have been 511 competitors in India for the forest service, of whom 110 have been appointed, all from the United Kingdom, "excepting one or two Eurasians—East Indians." From this it would appear that every student of forestry at the college, Cooper's Hill, has a fair chance of an appointment in India. The odds are not four to one against him. Here, in England, every competitor for a Government appointment is likely to have twenty to one against him; and who knows how much favouritism besides? The Indian forests, it seems, have disappeared in an extraordinary manner before the advances of civilization, besides the immense demand created by the railways for timber, especially for fuel, sleepers, &c. Gingera, on the

west coast of India, is a small State 40 miles long by 15 to 100 miles wide, which, except the rice land, was entirely covered with forests as lately as twenty years ago; and seven years later, when Mr. Pedder went there as Political Agent he found that three-fourths of the forests had been entirely destroyed by the demands of the city of Bombay. The land, apart from creeks, &c., is about 400 square miles. The area of British India, exclusive of Native States, is estimated at 865,000 square miles, and of these 48,000 have been brought under conservation as Government forests. Besides 27,000 square miles, which are partially conserved as protected district or village forests, about 9 per cent. of the whole country, has now been reserved as woodland and saved from certain destruction, which is considered a remarkable fact, and greatly to the credit of the Indian Forest Department. At page 9 of the report, question 124, we learn that India is almost entirely dependent on wood for fuel. But so was Europe ages ago.

The expense of a school of forestry in this country, as a Government establishment, would not exceed, in Mr. Pedder's opinion, £4,000 a year.

At the next sitting, on the 21st July, Colonel Michael, C.S.I., was examined. He had seen seven years service in the early days of Indian forest conservancy, but was driven away by jungle fever, and has paid attention to forest preservation and progress ever since. He stated that he had himself seen "a well known perennial stream dried up completely on the slopes of the Nilgiris by the fact that the timber all round it had been cut for coffee planting." The circumstance of the timber being cut is but scant evidence that the spring dried up in consequence. Might not the coffee plantation have something to do with it? But all the witnesses appear to have faith in that theory, though the springs do not dry up in those parts of Ireland which have been entirely denuded of trees. And in America the doctrine is often stoutly denied by men whose experience is no less than that of those who maintain it. Colonel Michael admits that he never knew the planting of a forest to have restored a spring, though he has known many springs lost from a forest being cut away. There may be other causes yet to seek for an explanation of this phenomenon. This witness thought that the establishment of a school of forestry in this country would be of great advantage to it.

At the last sitting of the Select Committee on July 24th, Dr. Hugh Cleghorn, M.D., F.R.S.E., who was twelve years conservator of the Madras forests, and began when Dr. Brandis began in Burmah, was examined. He has since his retirement from the service in 1869 paid great attention to the subject of forestry both in England and Scotland, and he considered it marvellous that means had not been taken at an earlier period to place our forests under trained officials in order to preserve them.

Dr. Hugh Cleghorn answered very carefully the leading questions that were put to him by the members of the Committee, but through all there was evident a steady belief in the great advantage the country would derive from a more methodical system of forest conservancy by means of an institution for promoting the knowledge and encouraging the study of forestry.

After him Colonel Pearson was called in, who represented the Indian Government at the school of Nancy for eleven years, and has great knowledge of the system of forest conservancy as practised in France. He also is a believer in what is called an approaching "timber famine," and therefore strongly advocated the promotion of new plantations in Great Britain, and the establishment of a school of forestry. Asked if the great bulk of the woodlands were not in private hands he admitted that they were, which of course would render it difficult for the State to deal with them. But there are hundreds of thousands of acres in this country still which might easily be acquired by the Government for planting as being at present entirely unproductive. We could point to thousands of acres of this sort within 30 to 40 miles of London, say between Woking and Winchfield on the South-Western Railway line, consisting chiefly of a fine white sandy surface, which seems never to have produced anything since creation, except heather, but in which oak, larch, spruce, Scotch fir, and birch will grow and make fine trees if planted. In bringing these lands under cultivation, or forest culture, employment would be found for an immense number of people, and the wonder is that they have only been tilled in small patches, and by cottagers mostly, but always with success, where the experiment has been made. To bring them into cultivation is estimated to cost about £10 an acre in labour and breaking through the hard subsoil, about a spade depth below the surface.

The examiners asked Colonel Pearson if he did not think a good deal of useful forest knowledge might be obtained by two months' attendance at a school of forestry instead of two years, which few would be able to avail themselves of except in the higher branches of the employment. He answered that in three months so much information might be acquired as would fit a student for a useful position, but not in less. Lectures might be attended at the discretion of the applicant, who might learn as much as he thought would be useful to him and no more. The institution would probably have to provide for this sort of desultory teaching, much on the system of day-boys at a public school, who do not obtain the same care in instruction and superintendence as the regular boarders, and pay less for it.

Mr. W. T. Thistleton Dyer, C.M.G., F.R.S., Assistant Director of the Royal Gardens at Kew, then gave his evidence. This gentleman's opinions of the great utility of a school of forestry

in this country, after the plan of those in Germany and France, coincided with those expressed by the witnesses who had preceded him, and he thought if such school of forestry were established there would be applications, by and by, from our colonies for competent men to investigate the state of their forests, with a view to other regulations in regard to them. The Cape Colony, from his testimony, has been very prodigal of its forest produce, and the amount of forest which exists there has been reduced to very small limits indeed.

It is a mistake, though, to assume that because a country imports timber from Scandinavia or America it is a sign of a scarcity of timber at home. Timber once afloat can be carried long distances by sea at less expense than to cut and haul a few miles by land, and the system of the timber-exporting countries is so complete that every convenience and facility for its transference is reduced to the smallest cost, and it is delivered, as it were, at your doors ready for use without any care or personal superintendance of yours till you absolutely see it there. Set this against going into the woods, if only ten miles away, and cutting down and getting home through every sort of inconvenience a hundred loads of timber which you are permitted to take for nothing where it grows.

The evidence of Mr. Julian C. Rogers, Secretary to the Surveyors' Institution, closed the sitting, and was much to the same effect as the others.

Our limits warn us that we must leave this interesting subject for a future occasion. But we cannot close our observations on the report before us without some reference to the Appendix, a well-written paper, and very comprehensive, on British forests, supplied by M. Boppe, Inspector of French Forests, which should have a separate notice, and is worthy of being printed in a pamphlet by itself, as very interesting to all who take an interest in British forestry. We must make reference to it again, as we have only room to express our approbation of its style and utility here. This paper was handed in by Mr. Pedder, but not as a translation. It is, nevertheless, difficult to imagine that it was not written by an accomplished Englishman. It is unexceptionable in the grammar and the idiom of our language.

The Report is printed by Hansard & Sons, and may be had for the usual price of Parliamentary papers, 7½*d.* It contains 52 folio pages in good readable type, 7 of which are occupied by the Appendix, and may be had through any bookseller.—*Timber Trades Journal.*

At the recent Railway Congress at Brussels the question whether it would be economical and desirable to use iron or steel instead of wooden sleepers was fully discussed. It was

stated that metal sleepers of various patterns are being used in Holland and India to a considerable extent, and that they are being tried experimentally in Belgium, England, and other countries. An opinion was expressed that sleepers of the description which is being tried in England would afford good material support for the rails on main lines, although some inconvenience might be felt from a quoin of wood being used with it. It was also considered that other metal sleepers which are being tried in Holland and elsewhere had given satisfactory results. The cost of metal sleepers is higher than that of wood. They require good ballast, and there had not been sufficient experience from their use, in regard to their duration and maintenance, to enable the section to state specifically the relative advantages of the new description of sleepers. It was therefore considered that further experience is necessary. The difficulty of arriving at a conclusion as to what would be applicable in all countries and under all circumstances was exemplified in the discussion of this subject by the representative of the Egyptian railways. He stated that iron or steel sleepers cannot be economically used in Egypt, because they become corroded by the sand. The representative of the Indian railways, on the other hand, informed the section that iron or steel sleepers only can be used in India, because the white ant destroys wooden sleepers. Considerable discussion took place as to the construction of railways in regard to the curves, gradients, and works generally, including the question whether lines with a comparatively small traffic should be laid with heavy or light rails. It was, however, found impossible to lay down any general propositions which could be adopted under all the circumstances in which railways have to be made.—*Nature.*

MECHANISM OF A TREE.—A tree (and I beg my readers to follow this attempt at explanation closely—all depends upon it) receives its nourishment from the roots. These correspond to the mouth in the human frame. Now, as in the human frame the nourishment received is, after being supplied to the blood, exposed to the operation of air in the lungs before it is fit to give material to the body, so in a tree, the nourishment taken in at these tree mouths, the roots, passes to the lungs of the tree, and there, by contact with the air, is rendered fit to supply fresh material to the tree. These tree lungs are the leaves. This operation is affected by the passage upward from the soil around the roots, through the trunk, the branches, and every twig of the tree to the leaves, of a large quantity of water, containing in solution the nutriment for the tree. Arrived at the leaves, a process takes place which separates, by means of contact with the air, most of the water the roots had taken in, from the valuable nutriment, and throws off, in vapour, the surplus

water into the air. At this time certain constituent portions of the air are utilized and mingled with the nourishment retained. This is all, now a small portion in comparison with what had arisen from the roots, yet retaining enough water to serve as a vehicle back, is returned toward the roots, depositing in its way, in leaf, bark, and root, what is needed there for the growth of the tree. In these, they undergo, especially in the bark, further fitting and digesting processes before they assimilate with the substance of the tree. The water which was retained to carry them down, being no longer needed, passes out at the roots. . . . In the back of the leaf are numerous stomates or mouths. . . . Of the extent of the provision made for evaporation by the leaves, some idea may be formed from a consideration of the number of *stomata* or stomates to be found in the leaves of plants. The number varies in different plants, for which variation a reason may be found in the different conditions of growth to which they are subjected in their several natural habitats. In the back of the leaf of the apple tree there are about twenty-four thousand stomates to the square inch. In the leaf of the lilac there are a hundred and sixty thousand of them to the square inch. In the leaves of the cherry-laurel there are none on the upper surface of the leaf, but ninety thousand have been counted on the lower surface—PHIPPS.

THE PYRENEES.—The desolation of mountain regions by the clearing of forests is strikingly illustrated in the Pyrenees. Formerly the plains were cultivated, and inundations were much less frequent and less destructive than now-a-days. As roads came to be opened the profit from sheep and cattle became greater, and the clearing of forests was begun to make room for pasturage and, to some extent, for timber, until by degrees the slopes of the mountains were denuded, and the rains, having nothing to hinder, began to form eroding torrents, the south slopes suffering most, because first cleared and directly exposed to the sun's heat. The extremes of flood and drought became excessive, and extensive tracts have been ruined for present occupation from this source.—PHIPPS.
